Engineer

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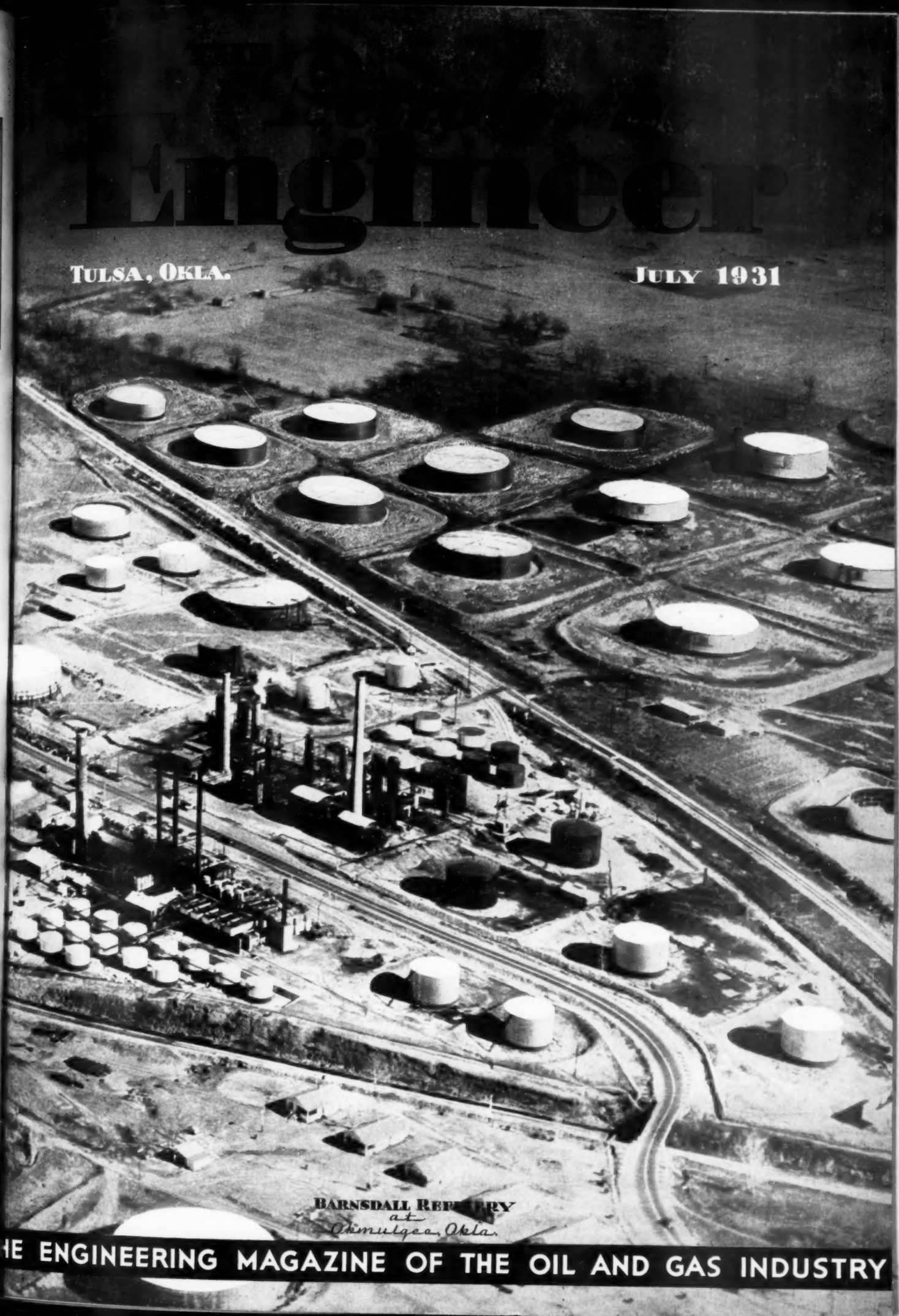

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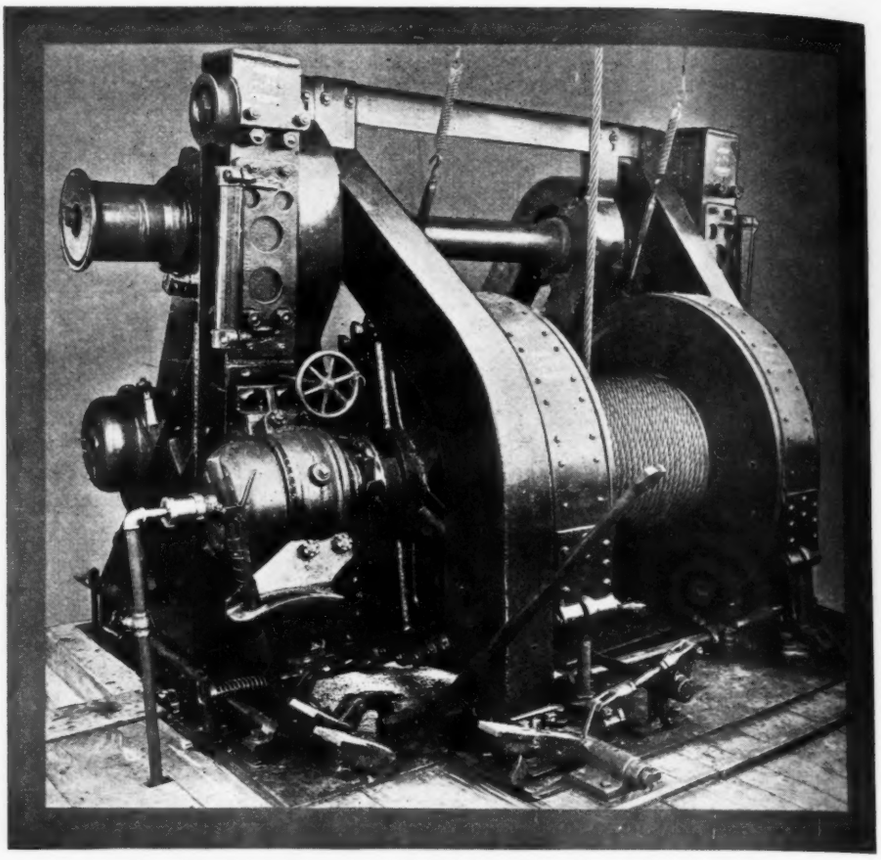

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THE MONTH'S HIGH LIGHTS IN OILDOM

By J. L. DWYER

JULY witnessed drastic price reductions on crude oil in the Mid-Continent field which were rapidly followed by reductions in the price of Pennsylvania oils. The new prices constitute the lowest levels which have been touched in the history of the industry for Mid-Continent oils.

The reductions came at a time when the market for refined products showed some semblance of improvement for the first time in a year and a half, and gasoline stocks were being reduced at a rate which seemed to hold favorable possibilities for stabilized conditions within the industry.

The blame for the new price schedules was placed upon the East Texas fields with their increase in potential production. The Humble Oil & Refining Co. was the first to reduce prices in Texas, and their action was followed by the Sinclair Oil & Gas Co., which extended the new prices to Oklahoma and Kansas fields.

As a result of the new prices, many wells will be shut down temporarily.

The new prices came upon the eve of the Texas Legislature being convened by Governor Sterling for the purpose of passing some emergency legislation to give additional strength to the oil and gas conservation laws in that state. It is believed that if this legislation is forthcoming, and the output of East Texas fields restrained to the point where they will not so heavily enter the market of other crudes, better prices will result immediately.

As this is written, there are 1,100 wells in the East Texas territory, and of this number 280 have ceased their period of natural flow. Artificial flow must be utilized if the production is to be obtained from these wells. An important number of wells are being rigged up for pumping equipment now, and there is every probability that this number will show a substantial increase next month.

In California the Barnsdall Oil Co. has evidently opened a new field with their No. 1 Tognazini in the Gato Ridge area of Santa Barbara County. This well flowed 1,100 barrels in one day from a depth of 2,501 feet. The oil is 16.1 gravity. The oil situation on the Pacific Coast seems to show some signs of danger, and a series of conferences are being held by several agencies in the hope of obtaining an improved industrial tone.

On the Gulf Coast of Texas, the daily average production has been held well under the figure of 140,000 barrels daily established by the Railroad Commission. Aside from a few interesting wildcats, there is little of the unusual in this region.

In Colorado, the Reiter-Foster Oil Corp. has a well on the Greenwood Dome which seems to have exceptional possibilities, and several new locations have been made as a result. Reiter-Foster has enjoyed exceptional success in wildcatting, and may be opening another pool in the Rocky Mountain region.

Production and Refining Figures Furnished by the American Petroleum Institute

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending June 27, 1931

(Figures in Barrels of 42 Gallons)

DISTRICT	Per Cent Potential Capacity Reporting	Daily Average Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Gasoline Stocks	Gas and Fuel Oil Stocks
East Coast	100.0	461,300	72.8	7,558,000	9,424,000
Appalachian	91.8	108,300	78.8	1,558,000	1,235,000
Ind., Ill., Ky.	96.6	321,300	76.2	6,311,000	3,766,000
Okla., Kans., Mo.	89.6	282,300	64.9	3,284,000	4,692,000
Texas	91.3	547,100	71.5	7,927,000	10,342,000
Lousiana-Arkansas	98.9	177,600	77.0	1,541,000	2,602,000
Rocky Mountain	89.3	46,100	32.4	1,833,000	862,000
California	96.5	472,900	53.7	*11,856,000	98,122,000
Total Wk. June 27	94.7	2,416,900	66.3	41,868,000	131,045,000
Total Wk. June 20	94.7	2,434,100	66.8	**42,300,000	130,251,000
Totl. June 28, 1930	95.7	2,627,400	74.5	49,700,000	139,437,000
The Texas and Louisiana Gulf Coastal figures shown below are included above in the totals of their respective districts.					
Texas Gulf Coast	99.8	414,600	78.0	6,777,000	7,377,000
La. Gulf Coast	100.0	118,900	80.6	1,433,000	1,662,000

Daily Average Production

(Figures in Barrels)

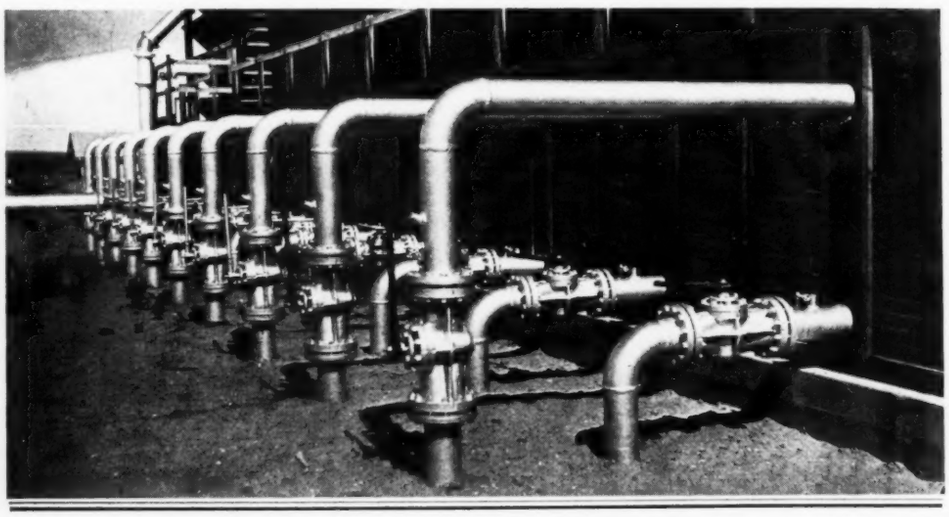
	June 27 1931	May 30 1931	June 28 1930
Oklahoma	544,300	527,700	666,950
Kansas	102,100	106,800	134,200
Panhandle Texas	59,450	61,800	108,000
North Texas	60,350	56,500	81,800
West Central Texas	29,550	26,400	61,000
West Texas	209,850	210,600	307,350
East Central Texas	59,800	55,600	40,100
East Texas	359,700	350,900	.....
Southwest Texas	58,650	60,550	78,100
North Louisiana	35,700	38,600	40,200
Arkansas	44,200	46,250	57,300
Coastal Texas	140,000	150,500	187,000
Coastal Louisiana	23,250	29,900	25,900
Eastern (not including Mich.)	100,750	102,800	126,000
Michigan	7,850	8,200	10,100
Wyoming	40,150	42,250	48,800
Montana	7,600	8,650	9,450
Colorado	4,650	4,050	4,850
New Mexico	44,550	45,700	26,550
California	509,500	528,400	597,300
Total	2,441,950	2,462,150	2,610,950

NOTE: In all the refining districts indicated except California, figures in this column represent gasoline stocks at refineries. In *California, they represent the total inventory of finished gasoline and engine distillate held by reporting companies wherever located within continental United States—(stocks at refineries, water terminals and all sales distributing stations, including products in transit thereto). **Revised in California District due to certain companies having incorrectly reported. New totals are: California, 11,788,000, and United States, 42,300,000.

Gas Line Booster Station

WHEN the Panhandle Eastern Pipe Line Co., builders of a 1,100-mile, 24-, 22- and 20-inch gas artery, stretching from the Texas Panhandle to Indianapolis, Ind., made plans for its compressor stations, the design embraced the most modern features of gas line power plant construction. They were laid out to obtain high efficiency in operation, low maintenance costs, permit station expansion at a minimum cost and promote greater safety. Under such conditions the stations are expected to show a small turnover in personnel and thus have crews familiar with every detail of the plants.

The initial station is located at Liberal, Kan., the junction point of the 24-inch coming up from the Panhandle and a 16-inch feeder line coming in from the Hugoton field to the west. The next station is at Louisburg, Kan., and a third is under construction in Illinois.



Detailed view of after-cooling inlet and discharge lines.

Liberal station is a 5,000-horse power plant housed in a sheet metal and brick building. The main station building has a full basement in which all of the below-floor level piping is suspended on the side walls and from the basement ceiling. The building was constructed with steel framework to which the metal sheets were fastened to build the side walls and roof. Brick was used to build that part of the station from the ground to the water table. The station was built by The Flour Corp., Ltd., engineers and contractors.

Particular attention was devoted to the lighting and ventilation of the building. Ample natural lighting is afforded by the double row of windows on the side walls and ends of the building. These also aid in the ventilation of the structure. In addition to the overhead lights throwing beams of light directly down on the units side lights were installed to prevent shadows. These cast their rays on a downward angle, cutting out the shadows in the otherwise darker sections of the station and on the units. All of the lighting wire is enclosed in conduits and the conduits for the side lights are attached to the craneway trackage. Each lamp is enclosed in a clear vapor-proof fixture.

The heating is done with blower type radiators located in the superstructure of the building. Three of these are located in each station and each heater has four blower tubes. The fan is behind the steam-heated radiator and the heat is blown downward to the station floor to obtain a greater circulation of air. During the warmer months the blowers may be used as fans to circulate fresh and cooler air through the building. This feature is expected to be more important when operating during the warm months of the year. Bugs and insects are attracted in droves by the station lights. During such periods the station windows may be closed and the fans used to circulate fresh air.

A type of floor finishing new to pipe line stations is being used on the station floor. Carbon black was used to darken the floors and then they were waxed with a special wax. Several days' time is required for the wax to thoroughly set before it is ready for polishing. When it is polished it has a glossy finish and is impervious to oil or water. It may be cleaned by running a mop over the floor.

Aside from the small tool work bench and gauge board, the station has little other equipment along the walls. Each station has its own machine shop and large tools are kept there or in the warehouse. Small fire extinguishers are located at convenient parts of the building and a few larger extinguishers are located along the walls.

Because the plant is located in a sandy section of the state where a stiff breeze is generally blowing, the air intake lines on the engines are fitted with air filters. These are located on the same side of the building with the exhaust lines.

The engines are 21½ by 36-inch, twin tandem 1,000-horse power units at 125 r. p. m. driving 13 by 36-inch, compressors. Lubricating oil for the units drains into a settling tank in the basement and goes from there to the filters before returning to the units.

Another feature of the station is that no valves, other than those absolutely necessary, are located inside the station. All of the valves on the suction and discharge lines and the by-pass lines are located on the header just outside the building. The suction and discharge lines come up through the floor with long and short radius bends to the compressor.

All station piping is located in the basement where natural light is afforded by windows opening to the header pit on one side and small windows on the other. Comparatively little piping is located on the compressor side of the basement. Suction and discharge lines are suspended to the ceiling with U bolts bolted to angle irons welded to the steel beams in the station framework. Lubricating oil lines comprise most of the remaining piping on this side of the basement.

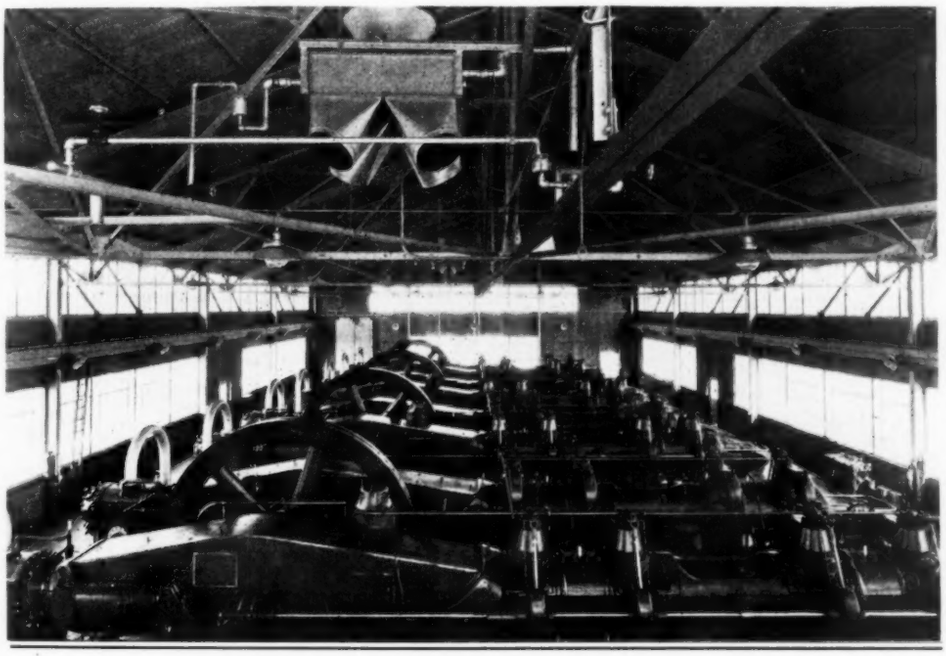
Conduits for both lighting and ignition systems are located

Embraces Modern Features

By J. H. DAMERON

on the engine side of the basement as are the fuel, steam, water, air and exhaust lines. These are either suspended from the ceiling or along the walls with clamps. All of the lines are painted a light color and are marked to facilitate their identification. The stuffing boxes through which the suction and discharge lines pass through the wall on the compressor side of the basement are designed to prevent possible leakage at the header gates from seeping into the basement along the suction or discharge lines.

The station's suction and discharge header is located in a concrete walled pit adjoining the compressor side of the building. It has a ladder leading to the bottom of it and a grating walk over the top so employes may manipulate the valves. The intake header is comprised of two 20-inch lines so connected that suction may be taken on either one or both at the same time. The discharge header is made with 24-inch pipe.



Interior view of station units, showing blowers and lighting arrangement.

Header barrels are anchored to the concrete pedestals on which they rest. All connections are welded to the header barrels and the flanges are welded to the radius bends. The 6-inch discharge and 8-inch suction lines are connected with a 180-degree radius bend 3-inch by-pass.

All of the discharge lines are equipped with relief valves set to pop at about 500 pounds pressure. In welding the header particular attention was given to obtaining a good weld. Whenever a reinforcing job was deemed necessary a strap 2½-inch wide was secured over the weld. Where the discharge lines were welded into the discharge header the welds were reinforced with half-inch boiler plate.

As in other installations about the station all of the valves on the header are the Venturi type. Except on the suction and discharge lines, all of the plug valves are opened or closed with wrenches. The former are operated with gate wheels and gears.

Incoming gas going to the compressors passes through a battery of four 500-pound scrubbers before going to the compressors. The scrubbers are made with pressure vessel material, welded. The gas goes through a mineral seal oil wash to remove sand and other foreign material. All of the connections to the scrubbers are welded and each scrubber is controlled by plug valves on its incoming and discharge sides. The scrubbers proved their value in the early operation of the station when they trapped considerable dirt and metal which would otherwise have reached the compressors and probably caused considerable damage to the pistons and liners. The scrubbers may be cleaned through a port in the bottom and charged with mineral seal oil from an adjoining tank. Charging is done with pressure.

Station water is obtained in abundance from four 200-foot wells drilled on the station site. Two of these wells are flowed by air and the other two are pumped with deep well turbine pumps. The water tests less than 11 grains for hardness and is used for both cooling purposes and domestic use without being treated.

Cooling water for the engines flows from the overhead tank outside to the units. It is picked up from the hot well and pumped over to the top of the large cooling tower. The gas aftercoolers are located near the bottom of the tower and the cool water sprays over them to reduce the temperature of the gas before it reaches the main line.

Because of the extreme variation of temperature near Liberal the overhead tank is equipped with a special design heater to prevent possible freezing during cold weather. The hot water from the units is circulated through the heater, located half way to the top of the tank and around the water lines, on its way to the cooling tower. This causes sufficient heat radiation to prevent freezing during severe cold weather.

Auxiliary machinery, circulating pumps and the heating plant are located in the sheet metal auxiliary building. The main auxiliary equipment consists of two 14¾ by 16-inch, 190-horsepower gas engines directly connected to the 156 KVA, 125 KW, 480 volt, 3 phase, 60 cycle alternators. These generate power for the station lighting, motor-driven compressors, circulating pumps and other auxiliary equipment.

The auxiliary plant has a gasoline engine-driven generating unit for extreme emergencies. The air compressors are two stage motor-driven units connected by V belts. The circulating pumps are located in a pit in the auxiliary building

and number six in all. Three are connected to circulate over the cooling tower and the other three are connected to circulate to the overhead tank or over the engines. The heating plant consists of a high-pressure boiler with automatic features.

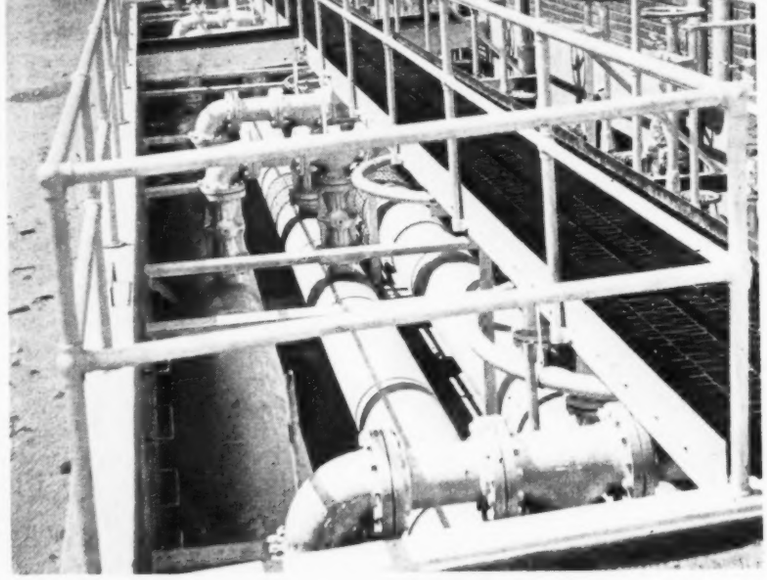
Air storage tanks are located just outside the auxiliary building. A battery of three welded tanks made with pressure vessel metal are set in a horizontal position on concrete foundations. Each is equipped with a relief valve. The air is used for starting the units and on other installations where air pressure is used to transfer oils from one tank to another. The lubricating oil is stored in two large tanks, one for light oil and the other for heavy oil.

The machine shops are designed and equipped to care for most any job that may arise at the station. The shop is housed in the same building with the warehouse. All of the machinery is motor-driven. The equipment consists of a 24-inch drill, hack saw, emery wheels, forge and anvil, a 13-inch by 5-foot lathe, a 24-inch by 14-foot lathe, and a 16-inch shaper.

The warehouse contains a stock of small parts and some large parts in addition to rubber and other gasket material. It has bins for the small parts with labels on them to facilitate inventory. All of the material and tools stored in the warehouse is kept in an orderly condition to permit quick inspection.

Above—Air filters and exhaust lines.

Below—Suction and discharge headers.



Metering and regulation equipment is housed in a separate building and the layout was made in duplicate. Gas for station fuel and domestic use comes in at line pressure and is reduced to about 20 pounds pressure by the high pressure regulator. It is then dropped on down to ounces by the low pressure regulator for station fuel and domestic use. Station consumption of gas is measured with a recording meter.

Communication along the line is maintained over telephone wires following close to the right-of-way of the line and the switchboard for the station is located in the office building. Cottages for station employes are located adjacent to the office building.

Safety at the station is constantly impressed on the personnel by frequent safety meetings and with bulletins. All moving parts of machinery and belts are enclosed with guard rails or shields. Open pits are likewise guarded and warning signs are placed about danger spots to constantly remind crew members of the dangers at hand.

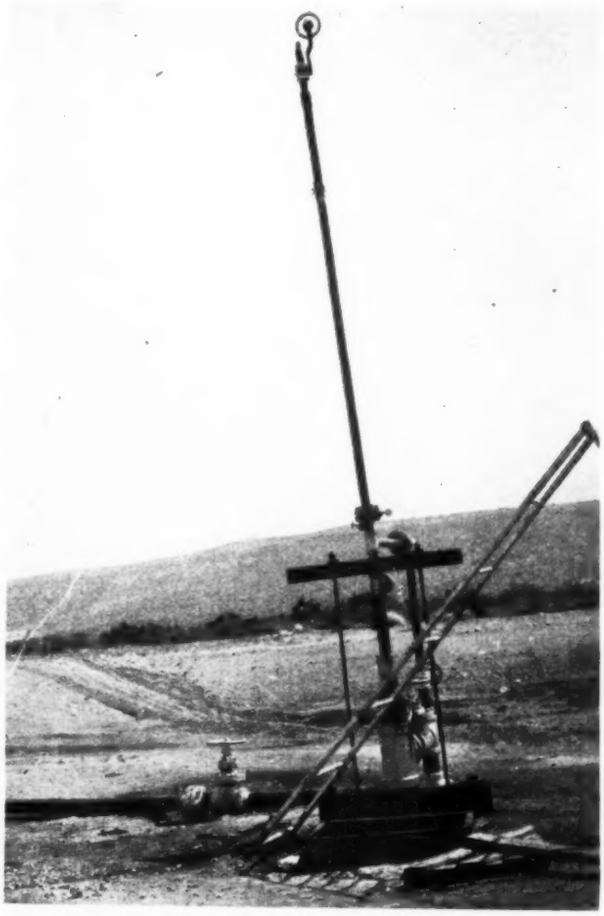
Bottom-Hole Beaning Has Useful Application on Producing Gas Wells

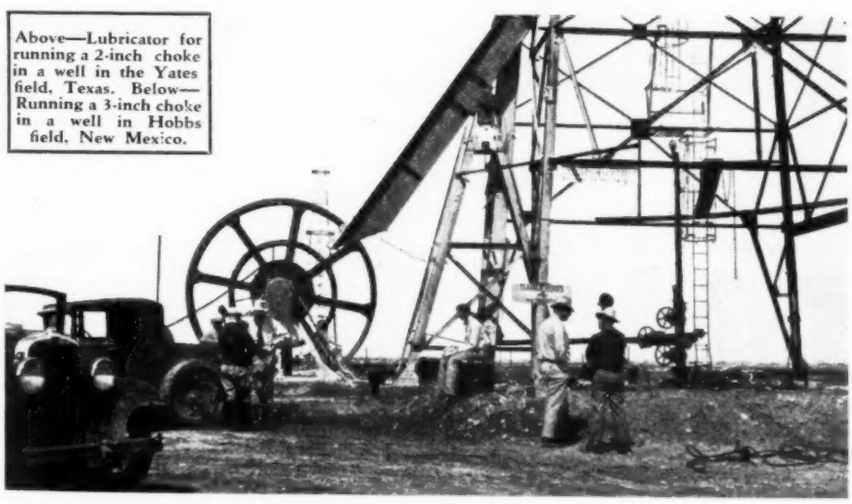
By K. C. SCLATER

ADAPTATION of bottom-hole chokes for the more efficient operation of producing gas wells is one of the most recent developments in the growing practice of bottom-hole beaning of wells. Heretofore, this practice has been applied mostly to oil wells for the purpose of lowering the gas-oil ratio. According to H. C. Otis, of the Southern States Company, Shreveport, Louisiana, who has had a long and varied experience in the operation of gas wells, and in recent years has been active in developing methods for installing equipment in high-pressure wells and still more recently in designing and developing a suitable type of removable bottom-hole choke, several tests made in the last few months on gas wells in the high-pressure gas fields of Louisiana indicate that the removable type of bottom-hole choke has an important application in the better operation of gas wells.

If water is present in the well a bottom-hole choke serves a dual purpose. Besides reducing the well delivery pressure to the point that the hazard of freezing of the gas well connections is eliminated, the bottom-hole choke, when inserted in the well siphon, aids in the effective removal of water with a minimum loss of gas.

Freezing at high pressure causes gas wells a great source of trouble during winter. At that season of the year the demand for gas is greater and a shut down more serious than at any other period. A well with a high casinghead or delivery pressure feeding into a line carrying a much lower pressure will, unless precautions are taken to counteract the chilling effect of the expanding gas, usually be a source of trouble if the winter temperature is extreme. To combat this, heaters of special design are used in conjunction with a series of orifices or regulators to provide a gradual reduction of pressure of the gas between the well and the line. The bottom-hole choke would seem to offer a satisfactory solution to this problem.





Above—Lubricator for running a 2-inch choke in a well in the Yates field, Texas. Below—Running a 3-inch choke in a well in Hobbs field, New Mexico.

By installing a removable choke nipple in the lower end of the siphon, or tubing, of a high-pressure gas well, it is possible to operate during the coldest periods of the year in extreme temperatures at a high efficiency and with a minimum of trouble. If the size of the choke opening is designed so as to take care of the maximum volume of gas, the well will be required to produce with a minimum pressure drop, no freezing will be experienced at the surface as expansion of the gas after it passes through the choke will take place gradually as the gas makes its way to the surface, thus dissipating a large part of the chilling effect produced by the expanding gas to the walls of the hole. The chilling effect that takes place as the gas expands through the choke nipple will be dissipated in the bottom of the hole with less harmful effect and less chance of freezing than were all or the greater part of the expansion to occur at the surface. At the bottom of the hole the temperature is more uniform and is not affected by the atmospheric changes that occur at the surface. This latter circumstance would be advantageous in the case of high-pressure gas wells that have to be produced where extremely low winter temperatures prevail.

In actual tests with bottom-hole chokes made in the

Hobbs field, New Mexico, it was possible to reduce the well casinghead pressure to only 7½ pounds per square inch with a bottom-hole choke. With a surface choke this well had a casinghead pressure of 1,200 pounds per square inch. Further tests made on the well with bottom-hole chokes of increasing size were successful in obtaining casinghead pressures up to 1,000 pounds per square inch. This demonstrates the wide range of pressures and well conditions under which a bottom-hole choke can be usefully employed. It is also an indication of its possibilities in high-pressure gas wells to prevent freezing.

Bottom-hole choke with cage.

For continuous operation of a gas well at its maximum efficiency it is essential that the well be kept free of water at all times. In many parts of the Mid-Continent it is the practice to produce a gas well through 2-inch tubing which also serves as a siphon for the removal of any water that may be present. This is especially true in flush wells where the volume of gas produced is large and consequently the flow velocity relatively high. As the volume and pressure of the gas diminish, however, the velocity of the gas is correspondingly lowered and eventually is not great enough to carry off the water as fast as it comes into the well. It is customary when this critical period is reached to resort to opening up the well siphon at intervals to the atmosphere and blow off the water that has accumulated in the hole. As the water accumulates in the well it gradually shuts off the flow of gas to the extent that the well will not produce against the line pressure in sufficient volume, and the blowing off process has to be repeated. This procedure of opening up the siphon line to the atmosphere is generally a costly process because of the excessive waste of gas it entails.

Eventually there is a stage reached in the producing life of the gas well when it becomes necessary to leave the siphon open continuously to the atmosphere in order to keep the well producing at a reasonable rate. Where a siphon of large cross sectional area is used the gas-water ratio resulting from this method of operating the well becomes excessive. Sometimes choking at the surface is resorted to, not always with satisfactory results, because the velocity of the gas in the siphon, the cross section of which is too large, is too low and serious by-passing of gas in the siphon results.

An alternative usually is to go to a siphon of smaller diameter. This assumes that the casinghead connections are such as to allow this to be done with safety and with not a great waste of gas. In any event, changing the size of siphon or tubing may turn out to be a time-consuming and expensive job, if it is to be done so that there will be no loss of gas, and fire hazards avoided. Lack of capacity and resulting inefficient operation may counteract the possible benefits of the small siphon after it is installed.

Another objectionable feature aside from the waste of gas that results from intermittently blowing off the siphon into the atmosphere is the liability of damaging the well itself. If the gas sand is loose, soft or has a tendency to cave, the sudden ejection of a column of water from the hole may cause the well to "sand up" and seriously impair the well's productivity. This would be especially serious in the case where water encroachment is rapidly taking place due to decline of gas pressure. This condition is encountered in the Richland gas field, Louisiana, where the producing horizon is made up of soft sand and shale.

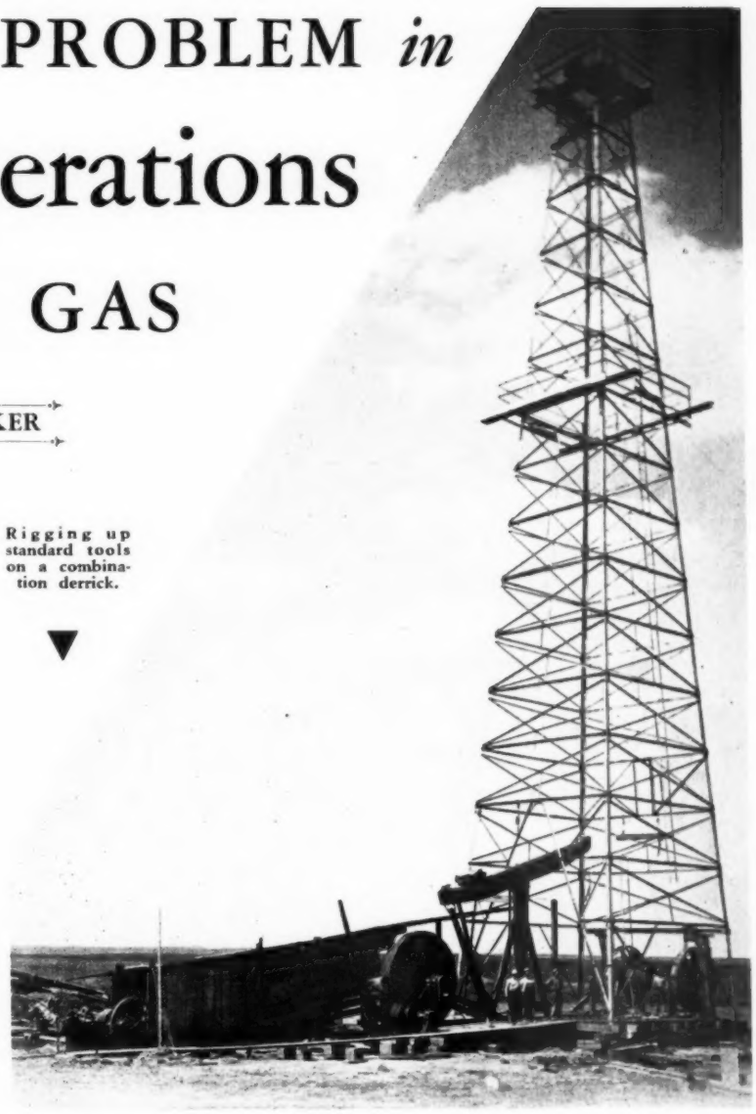
It was this condition that led to making tests in this field on the effects of bottom-hole beaning of gas well siphons, whereby the water is siphoned from the well continuously. So satisfactory were the results obtained that similar tests are to be made in other fields. The first gas well on which bottom-hole beaning tests were made is 2,450 feet deep and has a 2-inch siphon inside 8⅝-inch casing. The open flow of the well at the time of the test was 30 million cubic feet per day and the rock pressure 385 pounds per square inch. The well up until a short time prior to making the tests was produced entirely through the 2-inch siphon. A diminishing rock pressure, coupled with a lower rate of production from the well as the result of a falling off in demand brought about by the lower seasonal requirements made the operation of the 2-inch siphon inefficient for the removal of water. To try and correct this condition the gas production was then drawn from the casinghead and attempts made to remove the water more economically through the siphon by means of a choke nipple at the surface. This method had to be abandoned because of the large gas-water ratio of the siphon flow. Blowing off the siphon to the atmosphere was then tried. In order to prevent the well becoming loaded with water and to insure its feeding into the line against a line pressure of 345 pounds per square inch, it was necessary to blow off the siphon about every four hours. With this change in the method of operating the well a considerable increase in the amount of sand in the water was observed.

Installation of a choke in the bottom of the siphon utilizes to the best advantage the energy of the gas in expanding to lift the water. As the gas passes through the choke, it expands, its volume (and hence its velocity) increases. By virtue of this greater velocity the efficiency of the gas for carrying water upward in the siphon is increased. Were the siphon choked at the surface instead of at the bottom, the gas in the lower part of the siphon would be under greater pressure, hence would occupy a smaller volume and have in consequence a lower velocity. The small orifice of the choke admits only a small volume of gas to pass with the water into the siphon. Only a choke should be used that will give a minimum gas-water ratio and keep the well free of water.

The development of bottom-hole chokes of the removable type for use in high-pressure gas wells marks an important and progressive step in the operation of gas wells.

MUD LOSS IS PROBLEM *in* Drilling Operations *in* HUGOTON GAS FIELD

By WARREN L. BAKER



Rigging up standard tools on a combination derrick.

THE Hugoton gas field of southwestern Kansas and northwestern Oklahoma is an interesting gas reserve of tremendous possibilities that promises much in the way of future drilling exploration and development of gas production.

The comparatively shallow depth (2,600 feet) would lead to the opinion that drilling in the territory is very easy, but this is far from the case. It requires from 26 to 30 days to drill a test, and costs in the neighborhood of $25,000. Two formations penetrated in reaching the producing horizon give considerable trouble, due to loss of mud fluid circulation.

A sand of 30- to 60-foot thickness is encountered at 1,300 feet (just below the Blaine formation) that sometimes takes up all of the mud returns and always results in the loss of considerable drilling fluid. Another horizon resulting in practically the same drilling difficulty is a salt lens hydrate bed found from 1,700 to 1,800 feet. These beds are usually from 25 to 30 feet thick and wherever slopes or dips are present, the formation is fractured, causing much loss, and oftentimes upper sands will cave in and close around the drill stem, bringing about an unusually troublesome job.

Drilling mud weighing 10 pounds to the gallon is generally used, except when drilling in one of the above mentioned formations, at which time it is desirable to increase the weight of the mud to 14 or 15 pounds. It is always necessary to use additional mud to compensate for losses in these horizons, and to accomplish this, old slush pits are salvaged of their contents and additional material is obtained from nearby clay pits and mixed with commercial clays for this purpose. Two slush ponds and a reserve pit comprise the mud pit system.

Rotary drilling equipment is employed for drilling the hole to a depth of 2,575 to 2,590 feet, where standard tools are rigged up and are used to finish the hole. The depth of standardizing varies in different parts of the field. Rotary drilling is continued to a point slightly below the above figures in the western portion of the pool, while to the east, cable tools are rigged up at a slightly higher level.

The average rotary derrick used is 122 feet high and always of steel construction. The Argus Production Company, principal acreage holder, makes a practice of setting up an 84-foot standard rig when rigging up cable tools, thus permitting the rotary derrick to be used for starting a new test.

Drilling engines in use at Hugoton are of the 12x12 twin-cylinder type. Slush pumps, of which two are used at each well, vary in size, but most of the rigs are now using the larger, heavier type to facilitate handling the unusually heavy mud. Boiler installations consist of three 80-horsepower or four 75-horsepower boilers. Water for operating the rigs is obtained by drilling to a depth of 200 to 350 feet and it is brought to the ground surface by jetting with gas. Ample water supply is provided in this manner, but it is of fairly hard character, and not well suited for drilling purposes.

The casing program calls for the setting of about 600 feet of 12½-inch casing (cemented to the surface) to the top of the red beds. In some of the holes quicksand is

encountered at the surface, while in others it is not found. The next casing string is the 8¼-inch, ordinarily set at the standardizing point just above the producing horizon. The Argus Production Company uses this string as the flow casing, while the Panhandle-Eastern Gas Company has completed several wells with 6⅝-inch pipe. The Argus Company has in mind the idea of drilling these wells deeper at some future time. In the eastern district about 30 feet of open hole remains beneath the last string of pipe, with only eight to 10 feet of hole left open in the western portion.

The wells are not tubed and above ground connections are very simple, as shown in an accompanying picture. They are gauged for open flow production by the pilot tube method.

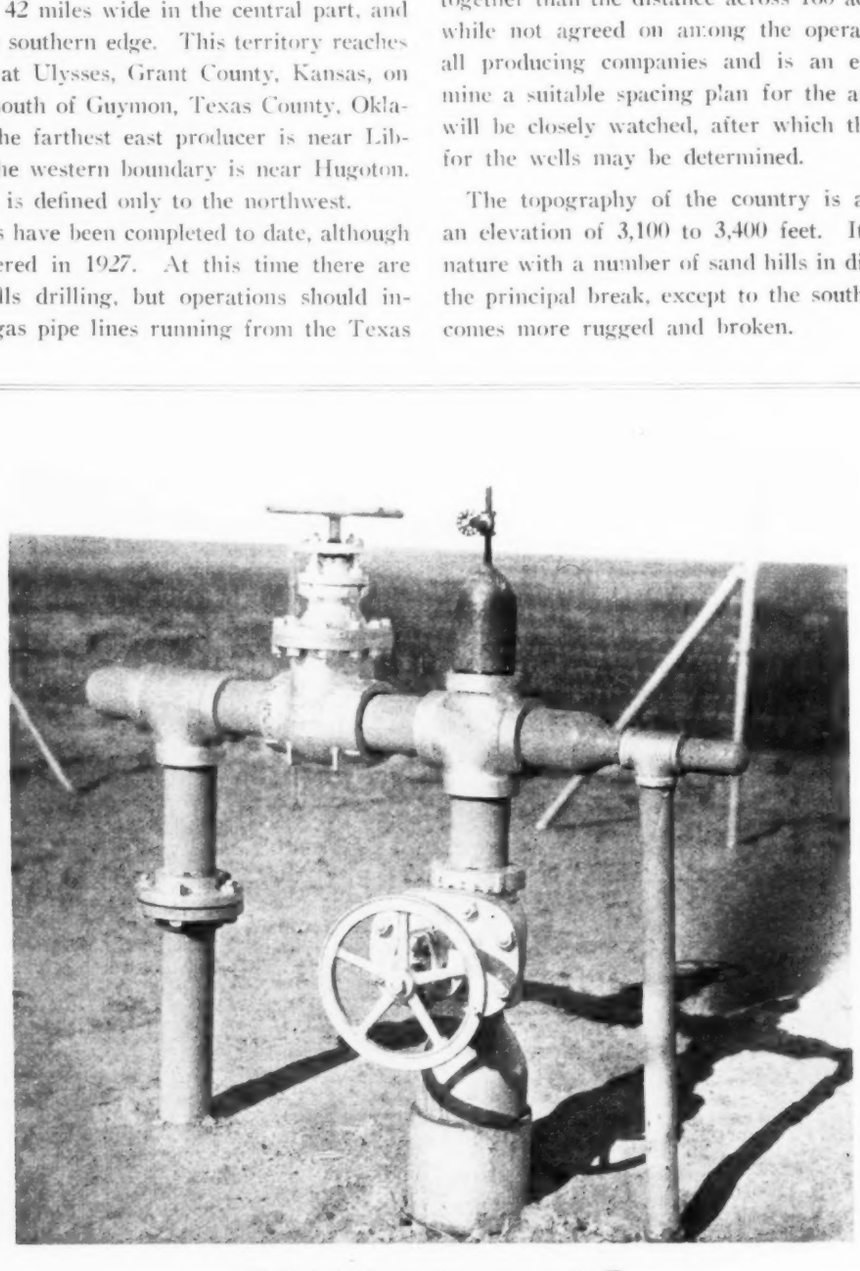
Visitors to the area are impressed at once by the widely scattered location of the wells and the unusually large number of undrilled proven locations. The district, as now considered productive, is 55 miles long, 26 miles wide in the northern portion, 42 miles wide in the central part, and 18 miles across at the southern edge. This territory reaches from gas production at Ulysses, Grant County, Kansas, on the north to a point south of Guymon, Texas County, Oklahoma Panhandle. The farthest east producer is near Liberal, Kansas, while the western boundary is near Hugoton. This impressive area is defined only to the northwest.

A total of 132 wells have been completed to date, although the field was discovered in 1927. At this time there are only a very few wells drilling, but operations should increase after several gas pipe lines running from the Texas Panhandle through Hugoton to eastern markets are completed. The 132 wells have a combined open flow of 816,042,000 cubic feet of gas. Most of the drilling development has been done within the last year and a half.

Production is found in a dolomite formation at an average depth of 2,600 feet. The average pay sand thickness is 48 feet, distributed through approximately 150 feet of dolomite. The average well is completed for an initial production of 7,000,000 cubic feet of gas daily. The gas is very sweet, has no sulphur content, and a B. T. U. rating of 1050. The pressure of the wells is 435 pounds, varying only slightly throughout the district. The low pressure is not thought to be alarming as the only possible water encroachment is believed to be from the east.

An interesting drilling development feature is the spacing of one well to each 160 acres. Thus far all the wells are situated in the center of the tract and no wells are closer together than the distance across 160 acres. This program, while not agreed on among the operators, is followed by all producing companies and is an experiment to determine a suitable spacing plan for the area. Decline curves will be closely watched, after which the best spacing plan for the wells may be determined.

The topography of the country is a high plateau, with an elevation of 3,100 to 3,400 feet. It is of slight rolling nature with a number of sand hills in different sectors being the principal break, except to the south where the area becomes more rugged and broken.



■ Casinghead connections on gas well. ■

Construction of . . .

Continental's Refinery *at* Denver

By W. M. HAYNES, *Asst. Chief Refinery Engineer, Continental Oil Co.*

THE author arrived in Denver on June 25, 1930, and began at once to make the necessary preparations for the construction of a modern refinery at Denver. Construction work was actually started on July 5. At the end of fifteen days there were from 60 to 70 men on the Continental payroll and the M. W. Kellogg Company, the contractors, had some 100 to 150 men on theirs. Excavating machinery moved in and started work on July 10, and this task was completed 30 days later.

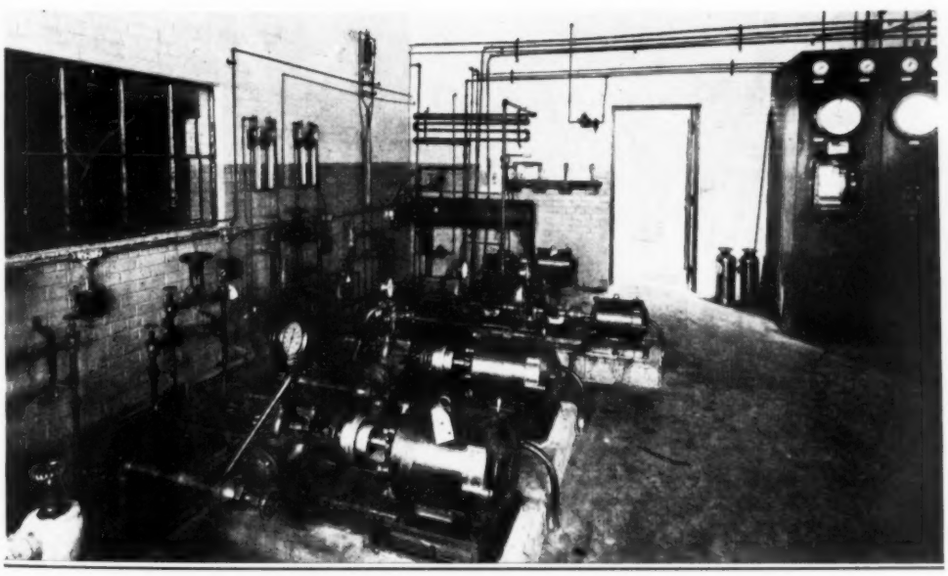
On July 5, tank construction began. Storage at the present time includes the following: two 55,000-barrel crude oil tanks; one 37,500-barrel gasoline tank; a series of tanks with a total capacity of 110,000 barrels (known as "transfer tanks"), designed for the storage of light oil, gas oil, kerosene and fuel oil; six 750-barrel run down tanks, operated in connection with the unit and designed for straight run gasoline, cracked gasoline, gas oil, kerosene, fuel oil and slop; three discarded Dubbs reaction chambers, converted into casing-head storage in connection with the treating plant; one 300-barrel lead lined gasoline agitator; one 750-barrel kerosene agitator and a modern circulating batch treating system for light oil. These storage units were completed on November 15.

The main Cross cracking and skimming unit was designed by Continental refinery engineers in co-operation with the Kellogg company. They furnished all material and prints and handled the construction work of the main unit. All other equipment was designed and installed by Continental.

One of the interesting features of the new unit is its compactness. Only 17 men are required to operate it, which is considered very unusual, in view of its 1,660-barrel daily crude capacity.

Another unique feature is the refinery hot oil pumping system, which is of the motor-driven, centrifugal type, operating under 950 pounds pressure and handling oil from 700 to 800 degrees in temperature.

The Denver refinery is practically 100 per cent electrically driven. This applies to all pumps; i. e., light oil, transfer, crude, charging, water, treating, crude unloading, casing-head, Ethyl, blending, and fuel pumps. There is only one steam pump in the entire plant and this is an auxiliary boiler feed pump. This set-up is considered one of the most unique and modern in America today. Poles are not used to carry electric lines, for all conduits have been placed underground. All motors are vapor-proof, explosion-proof, across-the-line. All switches are vapor-proof. There are no



Top—Loading rack at Denver refinery. Below—Pump house.

open type motors in this entire plant.

The Ethyl blending plant is also outstanding. It was constructed according to a special design submitted by the Ethyl Corporation, and embodies every improvement known. This plant is one of the best in the country. Conveniences provided in this structure include hot and cold water, shower baths, lockers for each employe and a private bath for the Ethyl operator. In the basement is a crude and casinghead unloading room.

Every building on the plant property is of brick as, of course, are the residences and garage.

The pump house is a structure 30x70 feet in dimensions, of reinforced concrete, steel and brick. This contains all transfer pumps, a room for treating pumps and a chemical storage room for treating supplies.

The Foamite mixing house is of the most modern design as also is the electric control house. The 24x30-foot water pump house which contains the water feed pump for the unit, fire pump and water re-circulating pump, is very compactly arranged.

The 40x60-foot main building includes the air compressor room, the boiler room, the control room for the skimming and cracking unit, and the superintendent's office and laboratory.

The hot oil pump house is 24x30 feet in dimensions, and contains Pacific hot oil pumps, charging pumps and transfer pumps for the unit.

The water supply for the unit is obtained from two wells, four feet in diameter, 26 feet deep, and producing 529 gallons of 52 degrees water per minute. The water used for domestic consumption is obtained from a 510-foot artesian well, operated by an electric power pump.

Mr. Fenex, the superintendent, is as well acquainted with his plant as any other superintendent in the country is with the one he operates. Here is the reason: during a major portion of the time that the plant was under construction, Mr. Fenex was on the ground helping with the work, and as a result, he has a complete working knowledge regarding the location and operation of every piece of equipment.

The company is proud of its Denver refinery recovery system, more familiarly known as the "slop trap." Sewers lead to all points in the plant where any spill is likely to occur, and the oil and water waste material is transferred to a special reclaim separator which effects almost perfect separation of oil, water and gasoline. It is very apparent, therefore, that economy of operation is stressed to the last degree.

The 1,000-gallon-per-minute cooling tower of California redwood reduces water temperatures from 90 to 65 degrees F., and operates in connection with a basin of reinforced concrete with a capacity of 200,000 gallons.

A very modern Conoco terra cotta service station has been constructed on refinery property next to the road, and has been enjoying a very thriving trade ever since it was opened.

The plant proper is confined to an area of 37 acres, which is enclosed by a six-foot, chain link fence, manufactured by the Colorado Fuel & Iron Company. The whole refinery tract, however, consists of 107 acres.

The underground system is considered very up-to-date. All fuel lines run at right angles to each other. There are no lines which cross each other. All lines running north and south have been laid 24 inches deep, and all east and west lines, 18 inches deep.

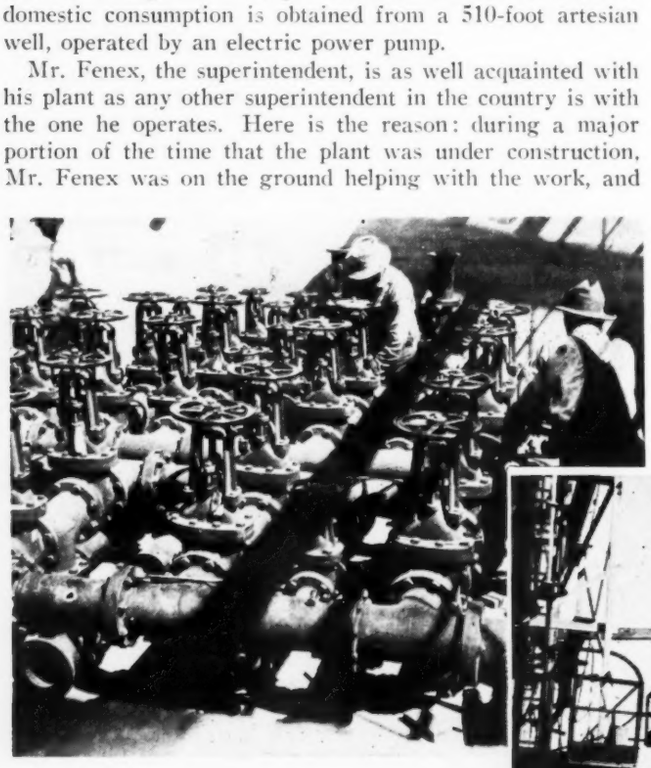
There is scarcely a second-hand piece of equipment in the whole plant. This, as you will readily understand, is another very unusual feature not common to other plants in the country.

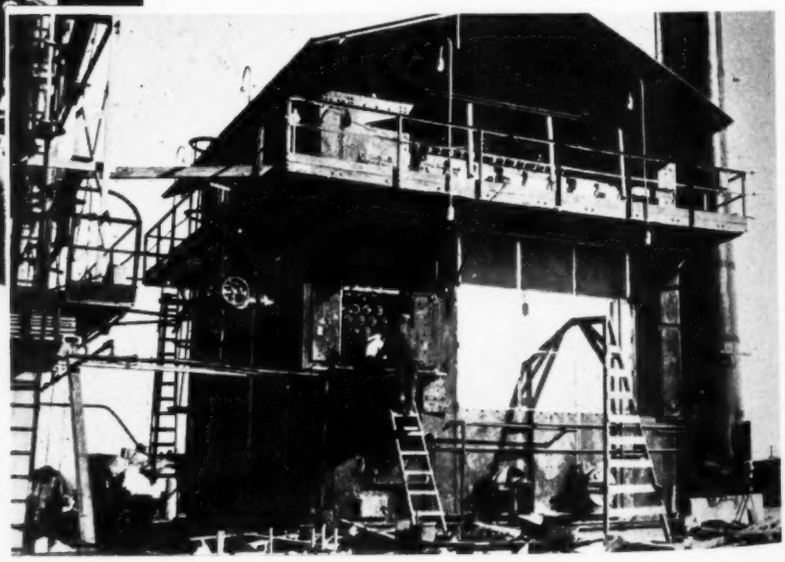
All contracts and all labor, with the exception of a small amount for which the Kellogg company is responsible, were secured in Denver, and a major portion of the material used there was also from Denver.

Another important feature of the plant is the illumination system. All outside lighting is handled by a series of floodlights. The center tower holds four lights and the two end ones two lights each. This equipment develops approximately 18,000,000 candle power and is so efficient that it is possible to read a newspaper in almost any portion of the plant after night.

The crude oil supply for the Denver refinery is shipped to Denver by tank car from the Wellington and Ft. Morgan fields in northern Colorado, a distance of approximately 65 miles.

A large percentage of the plant output will be delivered to Denver and vicinity by truck train.





Above—The light oil manifold. Right—Construction of pipe still furnace.

R. E. Ebner, Supt. of Emlenton Refining Co.

Cracking *to* IMPROVE Pennsylvania Gasoline

By F. R. STALEY

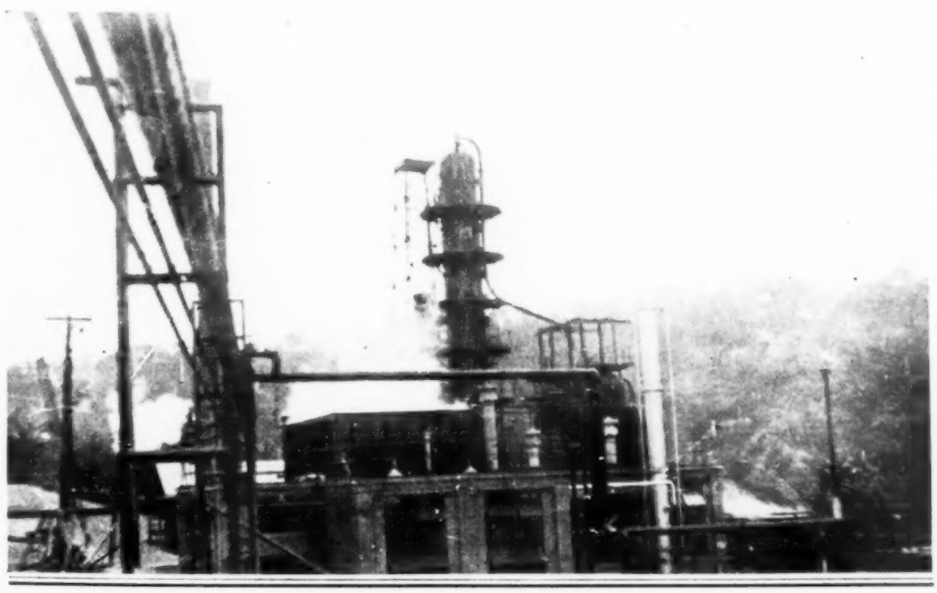
SINCE knock rating has been definitely established as one of the most important properties for consideration in the preparation of a motor fuel suitable for the modern high compression automotive engine most refiners have improved this quality of their gasolines considerably. The straight run gasolines from many crudes, as Pennsylvania, have a poor knock rating, or in other words, a low octane number. In order to market these products they must be first blended with a gasoline having a high octane number or else they must be fractionated to a low end point, thus sacrificing yields.

During the past year a number of refiners of Pennsylvania crude oil have installed modern units for cracking the kerosene and gas oil, producing a gasoline with a high octane number. Consequently they now manufacture an excellent motor fuel as well as the high grade lubricating oils for which the crude has long been famous.

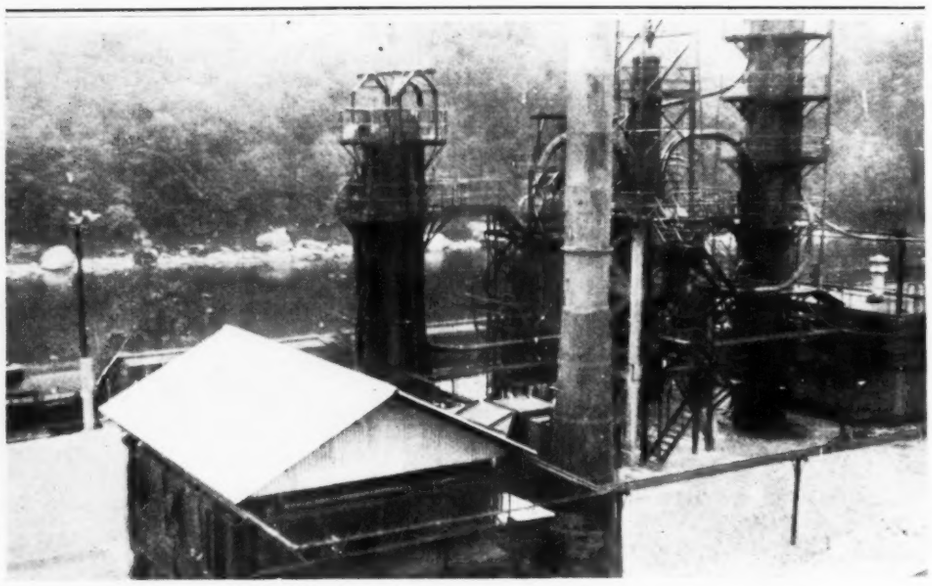
The Emlenton Refining Co. at Emlenton, Pa., has recently installed a Dubbs cracking unit which has been in operation for several months. It has a rated capacity of 750 barrels per day, and will crack either gas oil or kerosene, yielding a high percentage of gasoline with an octane number above 70. This cracked gasoline is refined in the vapor phase by two Gray towers, each having a twelve ton capacity. A 30-60 mesh Georgia clay is used in the towers. The finished gasoline is sweet, non-corrosive, stable to sunlight, and requires no chemical treatment. The company has let a contract for the erection of a stabilization unit for the cracked gasoline, on which the construction work will soon be started. The cracking unit is one of the most modern of this type ever built. It embodies many recent engineering developments in refining equipment. The unit comprises the furnace, reaction chamber, flash chamber, bubble tower, and two Gray towers, besides the accumulator tanks, pump house, and control instruments.

One of the interesting features of the new unit is the Alcorn furnace, the importance of which, to any cracking unit, can scarcely be overemphasized. The furnace contains 74 tubes, four inches in diameter and 24 feet long, placed in a single row along the roof, rear wall, and floor of the furnace, with a small economizer or convection section immediately ahead of the breeching. It is fired through ten short carbofrax muffles with unit control valves to insure complete combustion before any gases can come in contact with any of the tubes, and a distribution of those gases uniformly over the entire length of the tubes. The feature of this furnace is the radiant tube bank located on the floor of the furnace proper, below the burners. These tubes are purely radiant heat tubes as the path of the gases is upward and away from them. The temperature of the gases is reduced by the amount of heat absorbed by radiation, and consequently no tubes are subjected to a temperature that would cause overheating, overcracking or coke formation.

The tube arrangement is such that the entering oil first passes through the economizer or convection bank, then directly counter-current to the gases, passes through the roof tubes, wall tubes, and then through the radiant heated bank of floor tubes to the transfer, which point is located directly under the discharge from the combustion tunnels. Due to the method of firing, furnace design, and tube arrangement the furnace efficiency is extremely high, as very little excess air is required and



General view of new Dubbs Cracking Unit, Emlenton Refining Co., Emlenton, Pa.



General view of Cracking Unit, Emlenton refinery. (Alcorn furnace in lower left.)

heat distribution is very uniform.

The Ohio Valley Refining Co. and the Pennzoil Company have recently constructed similar cracking units, and several more refiners of Pennsylvania crude are planning or have actually started construction work on cracking units in order to produce anti-knock gasoline. The Kendall Refining Co. at Bradford has recently awarded a contract to Arthur G. McKee & Co. for a new unit.

The Emlenton refinery is located on the Allegheny River just north of Emlenton, Pa. It processes about 2,000 barrels of select Pennsylvania crude oil per day exclusively. A complete line of high grade motor oils and bright stocks are manufactured, as well as motor fuels, paraffine wax, kerosene, and special naphthas. Ethyl Gasoline is also blended at this plant.

The refinery equipment is of the most modern type. The crude oil is distilled in an atmospheric-vacuum unit, which consists of two pipe stills each equipped with fractionating towers. These units have been in operation for several years. They are highly efficient. Automatic control and recording instruments facilitate smooth operation. Gasoline, naphtha, kerosene, and gas oil are taken off the atmospheric tower and the reduced crude is picked up by a hot oil pump and charged to the vacuum unit. A wax distillate is taken off the vacuum tower, and the reduced crude or cylinder stock has a 555-degree F. flash point and about 150 viscosity at 210 degrees F. The vacuum tower can be operated to produce an overhead bright stock, but this is not the usual practice.

In addition to the crude oil distillation unit there is a rerun pipe still and fractionating tower at the plant to rerun the cold pressed distillate, and the naphtha solution of bright stock from the centrifuge plant.

The straight run gasoline from the crude is usually run for a low end point. It requires no chemical treatment. The naphtha is usually cut for cleaners' naphtha specifications. The kerosene is given a light acid treatment, using about two pounds of sulphuric acid per barrel. The gas oil is charged to the new cracking unit.

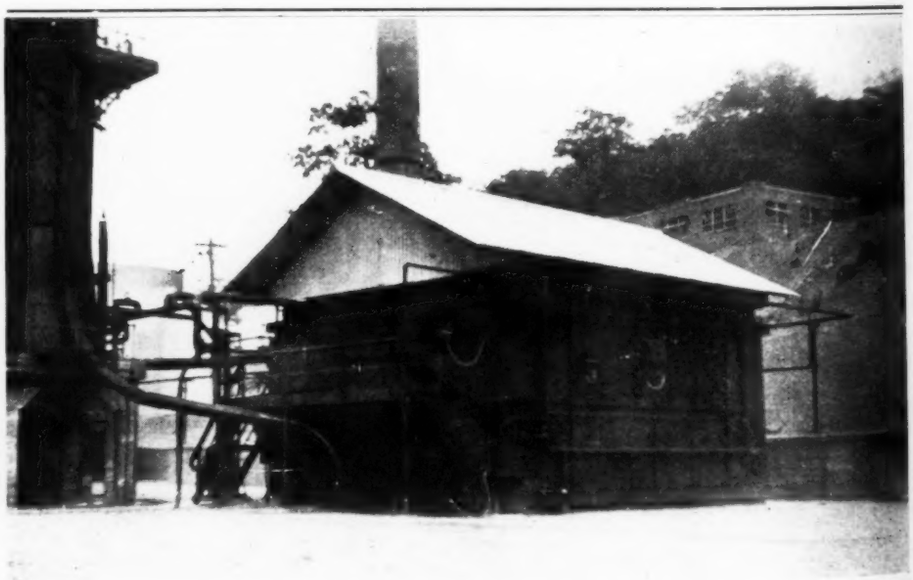
The wax distillate produced on the vacuum unit is pressable without any rerunning being necessary. It is chilled, and the wax is pressed out in either of two wax presses. The wax is treated in a sweat oven and shipped out in barrels. The pressed distillate is then rerun and fractionated into a viscous and a non-viscous neutral. The finished neutral is used for blending motor oils. It usually runs about 220 seconds Saybolt viscosity and 440 degrees F. flash point. It is filtered to the desired color by percolation through Georgia clay.

Bright Stock

The bright stock is filtered in solution by percolation. It usually finishes about a 7 N. P. A. color. It is dewaxed by super centrifuges. The installation consists of six machines, two of which are of the enclosed type. The finished oil runs about 20 degrees F. pour point, which is about the same as that of the blending neutral oil. The naphtha is distilled off in the rerun pipe still. The stock is then run through the percolator filter to strain it and give it a perfect demulsibility test. It is then ready to blend into motor oils.

In chilling the naphtha solution for the centrifuges, refrigeration is conserved by using the cold dewaxed oil from the machines through a heat exchanger to chill the feed. The filtered solution is first cooled with water to about 75 degrees F. and then with the cold dewaxed oil to about 30 degrees F., and finally to the desired sub zero temperature with brine.

The filter house is very compact and well designed to



Alcorn furnace on Dubbs unit, Emlenton refinery.

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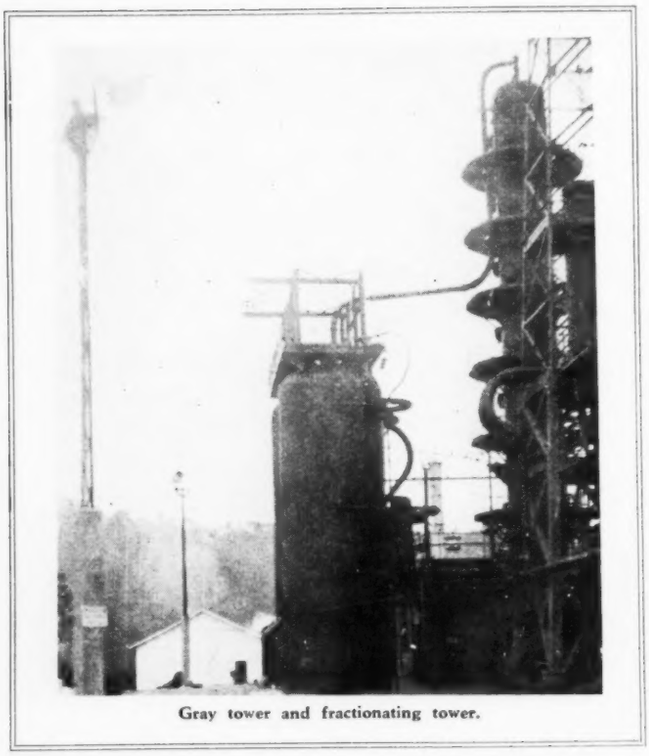


Gray tower and fractionating tower.

handle the stocks, and the neutrals. The kerosene is also filtered before it is shipped out of the plant. There are twelve 16-ton and six 8-ton filters used for filtering the bright stock solution. Four 8-ton and four 2-ton filters are used for straining the finished stock. Two 8-ton filters are used for the neutral oil. Only 30-60 mesh Georgia clay is used in the plant. It is revivified by burning it in a 50-ton multiple hearth furnace. The clay can be reburned about 35 times before it is discarded. In burning the clay the temperature is never allowed to exceed 1,000 degrees F. Although the rated capacity of the furnace is 50 tons, it usually burns about 72 tons daily.

Clay separators have been installed on top of the furnace which reduce the clay loss to practically nothing, and also prevent the deposition of clay over the entire refinery, which was the experience before their erection. These separators consist of two old percolator filters, about five feet in diameter, with cone bottoms. The hot gases containing the clay in fine suspension enter the separators from the side and strike the wall opposite which gives them a circular motion and causes the solid particles to fall into the cone which discharges into a bin on the ground floor.

The motor oils produced at the plant are usually shipped out in steel barrels. The barrel house is well equipped with conveying and weighing equipment.

These oils are of unusually high quality since the vacuum unit produces a very high flash, and the second filtration makes the emulsion test very nearly perfect. The viscosity-temperature relations, and the carbon residue for Pennsylvania oils is well known.

Boiler House

The boilers for the plant are housed in a brick building. There are four boilers consisting of one 500 horse power, two 250 h. p., and one 285 h. p., all are water tubular. They had been fired with automatic stokers, but are now being fired with Dubbs fuel oil which is about A. P. I. gravity. The boiler feed water is given a lime soda treatment.

Water for the boilers and the condensers is obtained from the river. A sufficient supply is always available.

This refinery has installed one of the first pipe stills ever used in petroleum refining. It was built about 1922 by the Power Specialty Co. (now the Foster Wheeler Corp.). A great deal of development and research work was done on it. It is equipped with a fractionating tower, and is now used for rerunning.

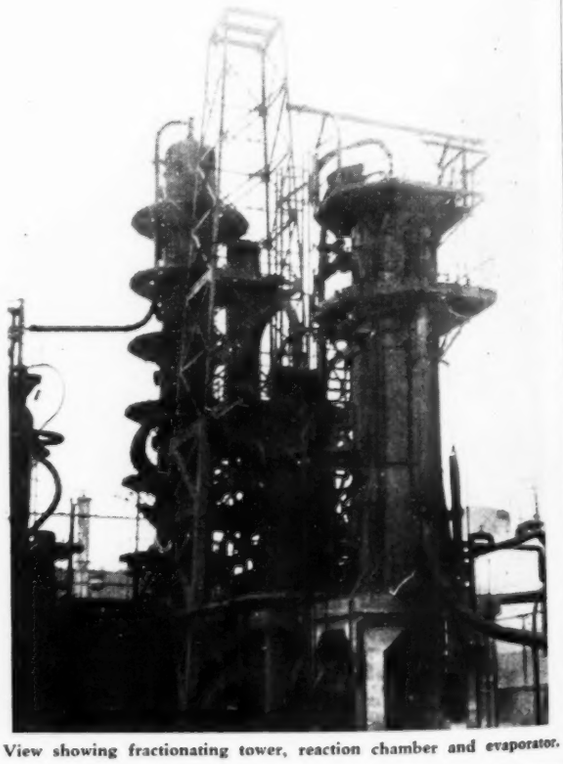
Research Laboratories

The refinery laboratory is one of the most modern and best equipped petroleum testing laboratories in this section of the country. Every type of apparatus is provided for testing both motor fuels and lubricants. The laboratory is located in a large modern two-story brick building. The company is at the present time preparing the second floor for a chemical and engineering research laboratory, which will be equipped to handle operating and development problems for the refinery.

Due to the hilly topography of the country it was necessary to do considerable grading at the refinery whenever a new unit was built. The crude oil tanks are built on a hillside so that the oil can be gravitated to the plant. All of the tanks for the new cracking unit are painted with aluminum paint. A floating roof tank has been built for storing the cracked gasoline produced on the new unit.

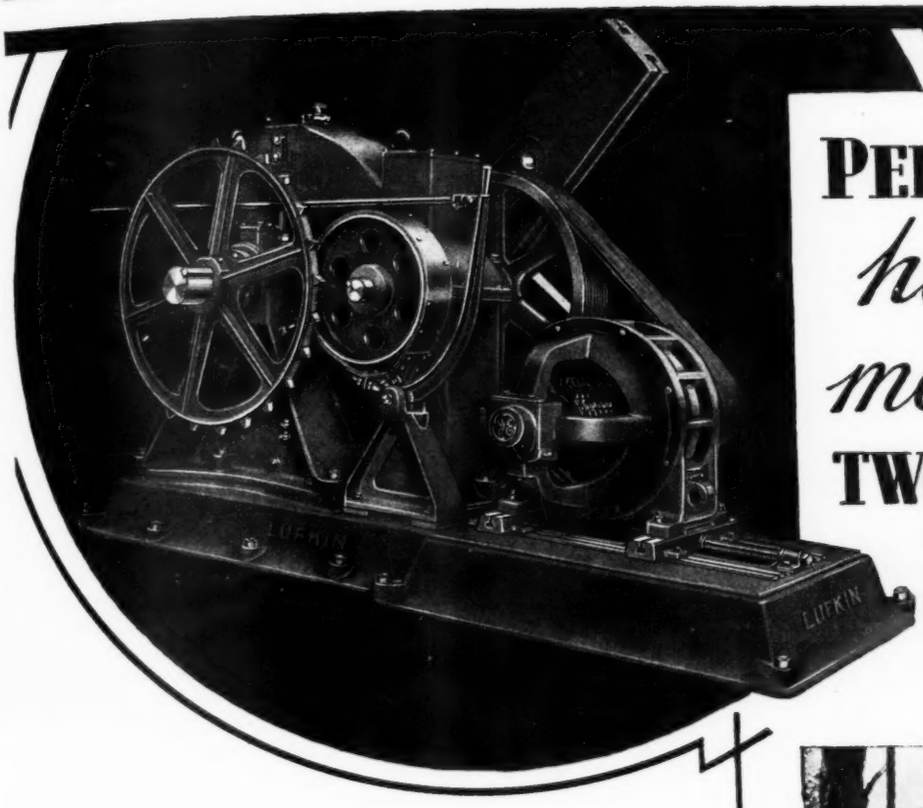
Many refineries located in Western Pennsylvania have processed for a long time Mid-Continent oils delivered to them in pipe lines. The straight run, and cracked gasolines produced from these crudes have a good high anti-knock rating, and consequently the refiner of only Pennsylvania crude, producing straight run gasoline as a sort of by-product with his lubricants was at a decided disadvantage. The modern cracking unit like the one installed at the Emlenton refinery enables these refiners to produce a high grade motor fuel as well as this grade of motor oils.

G. B. Hunter is general manager of the Emlenton Refining Co., and R. E. Ebner is superintendent of the plant.



View showing fractionating tower, reaction chamber and evaporator.

PERFORMANCE

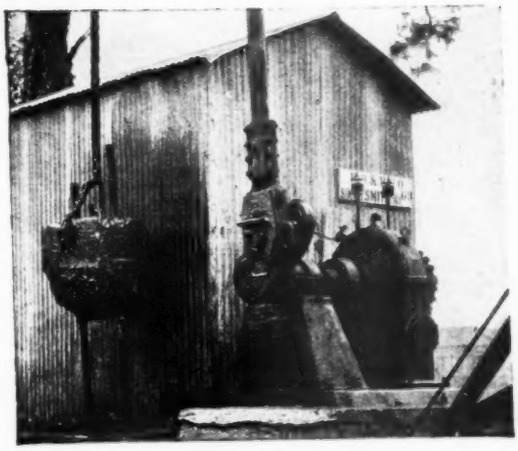


PERFORMANCE *has sold more than* TWO THOUSAND LUFKIN UNITS

Performance—in the field under all sorts of operating conditions—with a minimum of expense and maintenance cost, is alone responsible for the phenomenal success of LUFKIN UNITS. Performance so efficient as to merit order after order from Major Operators whose Engineering Departments have recommended their use. They have to be good to warrant such endorsement.

Ease of adaptability to any type of prime-mover—elimination of fire hazard and large expensive band wheel houses—lowered production costs and increased operating efficiency—ease in transferring from well to well (with only the loss of foundation)—these and many other reasons make LUFKIN EQUIPMENT the ultimate in Modern Production Methods.

Without obligation, Lufkin Representatives will gladly submit complete details for your particular requirements—or a completely illustrated catalogue containing blue print setting plans and "hook-ups" of all types of applications—a virtual engineering hand-book—will be gladly mailed you upon request. Write for your copy today!



THE FIRST LUFKIN UNIT—still in operation on a Gulf Coast Lease. Several hundred units have been sold to this operator as a result of the performance of this unit.

LUFKIN
PRODUCTION EQUIPMENT

»»»Manufactured at Lufkin, Texas, by «««
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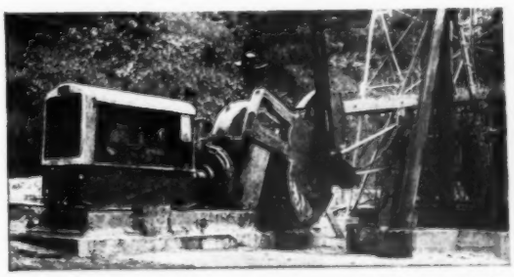
Henderson, Tyler, Longview.~ ~ ~



Dependable performance is the thing required by the foreign buyer—that is why LUFKIN UNITS are favored in foreign fields. Above is an installation in the Francito field, Puerto, Mexico.

When writing LUFKIN FOUNDRY & MACHINE CO., *please mention The Petroleum Engineer*

Reinforcing Welded Connections *on a* By-Pass

IN the construction of a by-pass on a high pressure, large diameter gas line, the abrupt change of flow of the gas sets up a severe stress on the welded joints. To reinforce the joints to withstand such stresses various types of reinforcing are used.

Many successful reinforcing jobs are being done with triangle-shaped reinforcements in addition to the conventional type of strap iron.

On a recent job where a 20-inch by-pass was made up in the field this type of reinforcing the welded joints was one of the features on the job.

Left — General view of by-pass. Below — Detail of reinforcing straps and lugs to jack flanges up.

When the welding was done it was practice to make the saddle weld joining the by-pass to the main line a little heavier than an ordinary field roll weld. This was first reinforced by welding straps over the tip ends of the saddle. Half way between the two straps or 90 degrees around the pipe from the top, the two triangle-shaped plates were welded in. Half way between the triangle plate and the strap reinforcements, V-shaped straps were welded over the joint.

All of the reinforcing material was obtained from short lengths of line pipe scattered about the job. A welder with a cutting torch cut the shapes from the pipe and then bent them. In welding the material over the joint the welder started the weld at a point near the saddle weld and worked around to the same point on the opposite side of the strap. By making the U-welds the two sets of welds were kept about an inch apart.

On this by-pass construction job the Vanstone type of flange joint was made, where valves were flanged in. The pipe is belled at one end and the flange slipped over the other. When the flanges are bolted together a tight joint is made and is more flexible whenever necessary to remove the valve. Sometimes it is difficult to get the flange up to the bolt circle on the opposite flange. To avoid delay and difficulty lugs, made by cutting small pieces from discarded short lengths of line, were welded to the pipe a short distance from the flange after it had been slipped on the pipe. When it was difficult to move it forward it is a simple matter to jack it into position by bracing the jacks against the lugs.

Another interesting feature in connection with the construction work was the use of factory bends. In the design of the by-pass it was decided it would be more economical to buy "tailor-made" bends rather than bring in equipment to make the few fire bends. These were welded to the piping and fitted into the general piping without any changes.

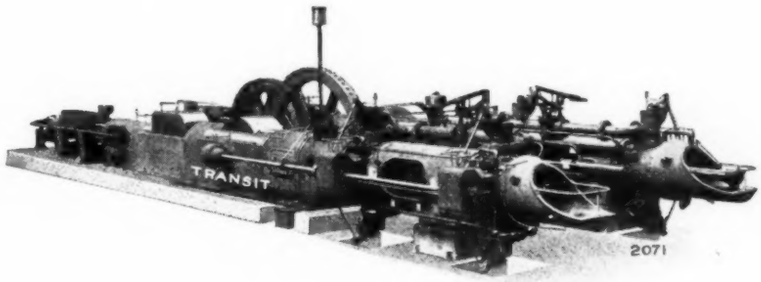
The entire assembly was made up on the job and with the use of lowering horses, moved over the ditches and placed on skids. When the line was ready to be taken out of service the nearest gates were closed and everything made in readiness to tie in the by-pass. A section of the old line was cut, removed and the by-pass lowered and welded in, necessitating blocking the line for only a few hours.

Keen, Daring Minds Build for Progress

The development of a gas engine driven hot oil pump, using refinery gas as fuel, called for keen and experienced engineering talent.

Formerly refinery gas was burned most wastefully, but TRANSIT engineers, by utilizing it in the most profitable way, have made possible another long step forward in refining economy.

We will be glad to give you detailed information and refer you to actual operating installations.



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Builders for Progress in the Oil Industry

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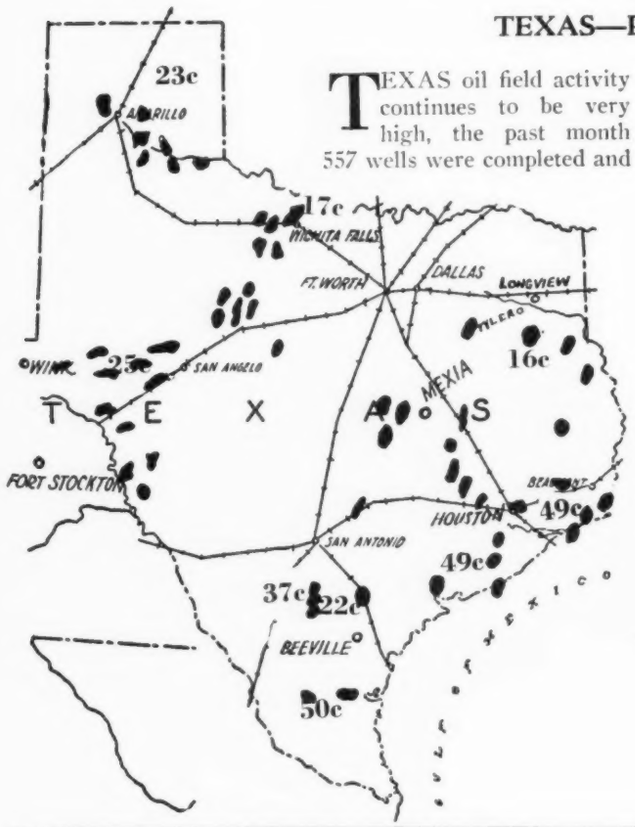
Latest Activities *in the* Oil Fields*

TEXAS—Production, 1930—290,720,000 Barrels



TEXAS oil field activity continues to be very high, the past month 557 wells were completed and 606 new drilling permits were issued. Drilling activity showed a slight increase when 1,012 active tests were reported from the area, in which there was also 245 rigs.

The East Texas district alone has more activity, including completions and drilling wells, than any other state in the Union and is the greatest factor in boosting Texas operations so far above the remainder of the states. Thus far the East Texas activity has shown no signs of a major let-up.

Following is a tabulated review of the active areas:

	POOLS			
	East Texas	Panhandle	Van	Refugio
Number of Permits	423	7	8	1
June Completions	357	9	11	4
Number of Rigs	267	20	3	1
Number Drilling Wells	322	18	13	11
Gravity of Oil	40	40	36	26
Depth of Production	3600	2900	2600	6500
Type of Tools Used	Rotary	Rotary	Rotary	Rotary
Number Casing Strings	2	2	2	3

CALIFORNIA

Production, 1930—228,612,000 Barrels

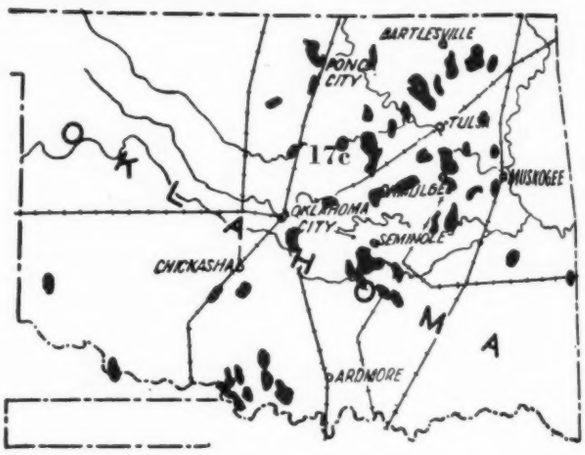
The state of California had 26 completions last month. There were 53 drilling permits issued during the same period. This state had 28 rigs and 269 drilling rigs at the end of June. This activity report is the lowest number of operations carried in California in many years.

Following is a survey of operations in the state's most active fields:

	POOLS			
	Playa Del Rey	Long Beach	Kettleman Hills	Ventura
Number of Permits	3	6	1	2
June Completions	6	3	4	6
Number of Rigs	2	3	1	1
Number Drilling Wells	9	27	17	4
Gravity of Oil	23	26	60	36
Depth of Production	6000	7000	8300	7800
Type of Tools Used	Rotary	Rotary	Rotary	Rotary

OKLAHOMA

Production, 1930—214,425,000 Barrels



Oil field operations in Oklahoma continue to slump lower and lower, and without any new pool on the horizon it appears that there will be increase in the near future.

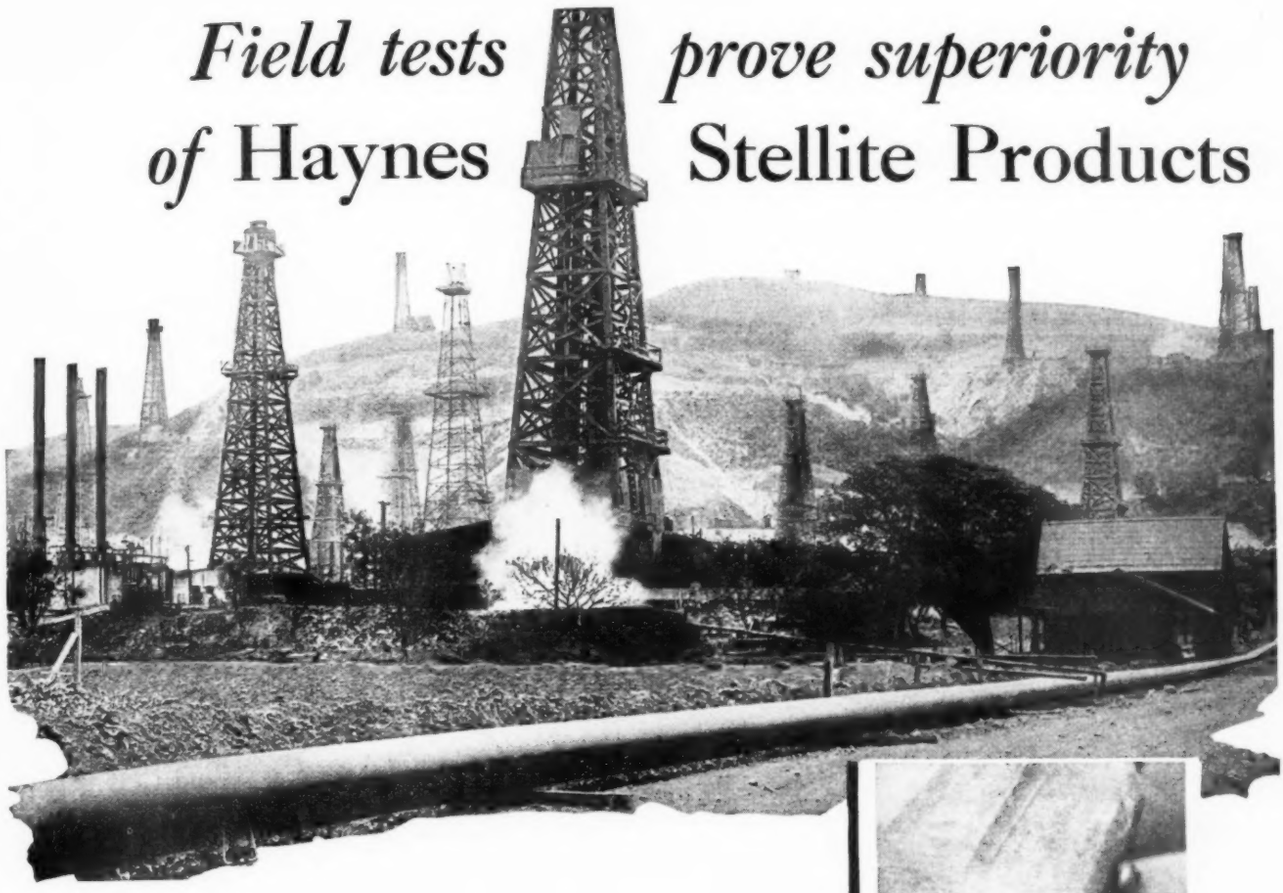
Following is a summary of Oklahoma's activity:

	Entire State	Oklahoma City
Number of Permits	55	8
June Completions	101	21
Number of Rigs	57	15
Number Drilling Wells	113	48
Gravity of Oil	36 (average)	39
Depth of Production	Varies	6400
Type of Tools Used	Cab.-Rot.	Cab.-Rot.
Number of Casing Strings	Varies	3

Figures on maps indicate average prices of crude oil per bbl.

* All statistics as of July 1st.
● Denotes oil and gas fields.

Field tests prove superiority of Haynes Stellite Products



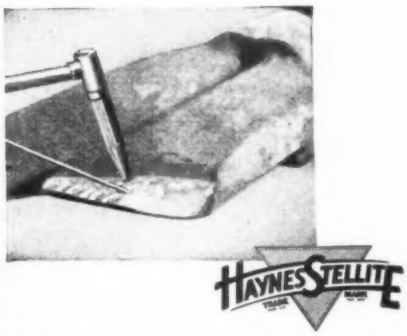
TEXAS oil-field records for the diamond substitute Haystellite, and for the wear-resisting alloy Haynes Stellite, are but typical.

At Spindle Top, bits hard set with Haystellite averaged 55% more footage per hour than the best hard set bits previously used . . . and established an average drilling record of 111 feet more per bit. In a 5,000 foot test well, hard set Haystellite bits gave an average of 50% more footage. From South Corsicana come reports of a company adopting Haystellite as the standard material for hard-setting core drills and fishtail bits, after conducting the most extensive tests.

Haystellite, while almost diamond hard, is tough enough to withstand the impact of drilling without chipping or crumbling. Drilling tools hard set with Haystellite and hard surfaced with Haynes Stellite give the greatest round-trip footage with the maximum drilling speed.

Return the coupon for the newest book by the pioneers in the development of hard surfacing materials.

Small pieces of Haystellite, the cast Tungsten Carbide diamond substitute, welded in place.



Surfacing a Haystellite hard-set bit with Haynes Stellite — the wear-resisting alloy of Chromium, Cobalt and Tungsten.

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

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General Office and Works — Kokomo, Indiana

Haynes Stellite alloys are available also at all of the 42 apparatus shipping points of The Linde Air Products Company

Haynes Stellite Company, Kokomo, Indiana

Without obligation on my part, please send me a copy of your new book, "Haynes Stellite Products in the Oil Fields."

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Company.....Position.....

Street Address.....

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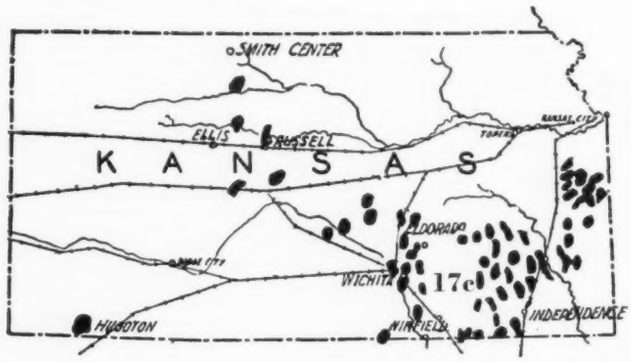
When writing HAYNES STELLITE CO., *please mention The Petroleum Engineer*

KANSAS—Production, 1930—41,745,000 Barrels



Kansas had 43 drilling permits and 46 completions during June, the end of which time saw 45 rigs and 73 drilling wells in the state. Both rotary and cable tools are used in the state, with the latter predominating.

Following is a summary of the active fields:

	POOLS		
	Sedgwick County	McPherson County	Hugoton Field
Number of Permits	3	21	0
June Completions	5	17	6
Number of Rigs	2	20	4
Number Drilling Wells	5	38	2
Gravity of Oil	36	37	Gas
Depth of Production	2900-4250	2900-3400	2750
Type of Tools Used	Cab.-Rot.	Cab.-Rot.	Cab.-Rot.
Number of Casing Strings	2	2	2

ARKANSAS

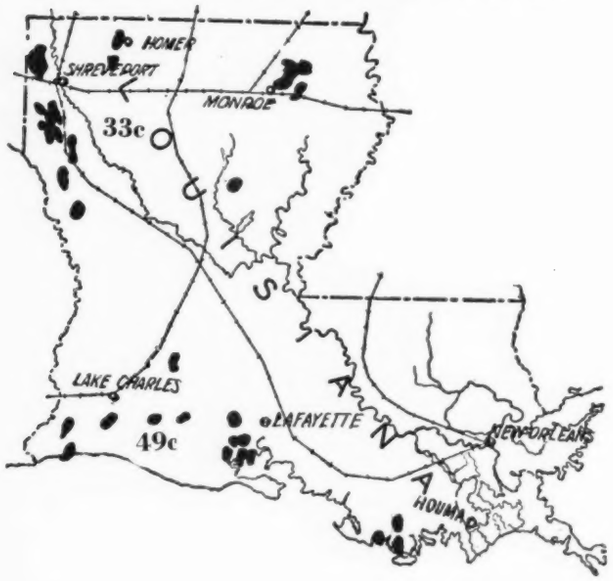
Production, 1930—19,680,000 Barrels

Arkansas oil field operations consisted of 8 completions and no new drilling permits during June, with 5 rigs and 31 drilling tests at the end of the month.

Rotary tools are employed by operators to do the drilling here, where heavy gas pressures and soft-cavey formations are frequently encountered.

LOUISIANA

Production, 1930—23,150,000 Barrels



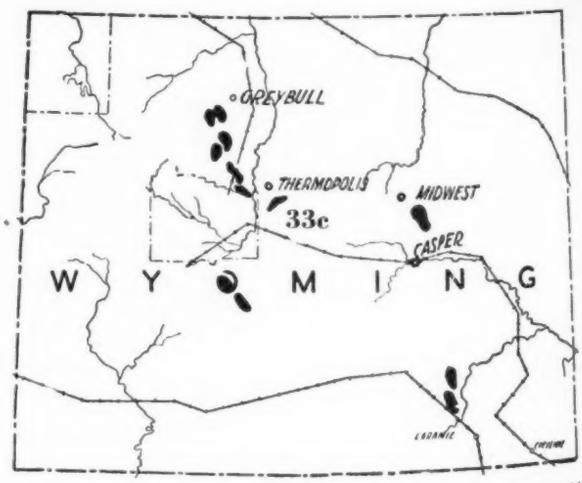
Louisiana oil fields had 86 drilling tests and 23 rigs, and 35 completions and 26 new drilling permits granted during June. Rotary tools are operated throughout this state.

Mississippi, adjoining Louisiana to the east, had 2 completions, 5 rigs and 13 drilling wells last month. The play in Mississippi is centered around gas production found at Jackson.

WYOMING

Production, 1930—11,177,000 Barrels

Wyoming had four completions last month. This state had 13 rigs and 80 drilling wells, the majority of which were cable tool installations, although some of them were using rotary tools for drilling.



● Denotes oil and gas fields.

Figures on maps indicate average prices of crude oil per bbl.

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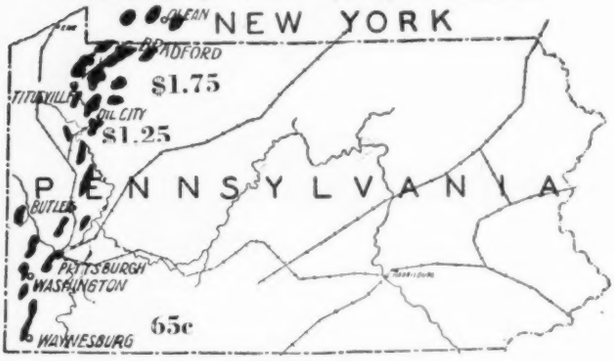
NEW YORK

Production, 1930—3,825,000 Barrels



PENNSYLVANIA

Production, 1930—12,810,000 Barrels

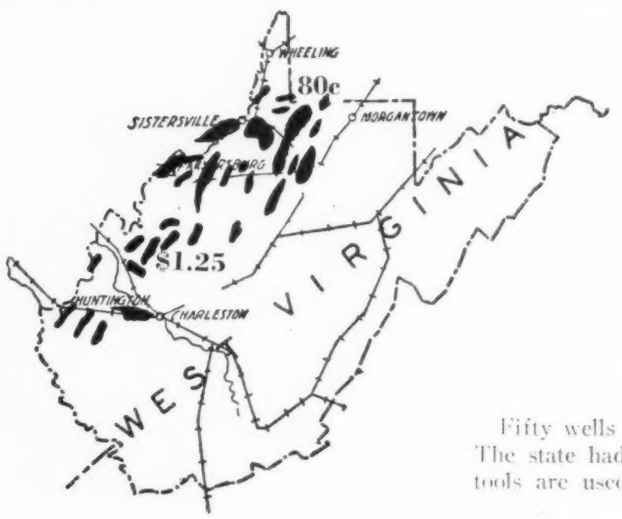
There were 43 completions in Pennsylvania and New York states during June. These two states had 15 rigs and 83 drilling wells at the end of the month. The Tioga gas field continues to be the center of much interest.

ILLINOIS

Production, 1930—5,695,000 Barrels

The past month saw the completion of 3 wells in Illinois. The state had 3 rigs and 20 drilling wells the last of June.

All of the drilling is done in this state with standard tools, producing depths being shallow and offering no unusually difficult drilling proposition.

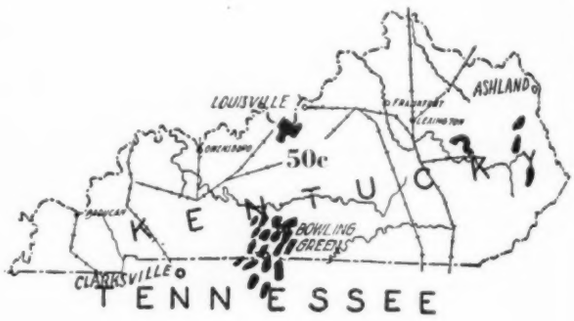


KENTUCKY

Production, 1930—7,300,000 Barrels

Kentucky had 20 completions, 12 rigs and 95 drilling wells during June. Tennessee had 3 completions, no rigs and only 14 drilling wells.

Drilling in both states is accomplished with standard tools.



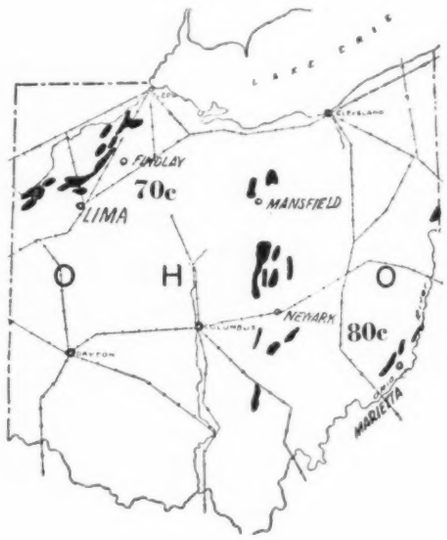
TENNESSEE

Production, 1930—20,000 Barrels

OHIO

Production, 1930—6,525,000 Barrels

There were 82 tests completed in Ohio during the past 30 days, at the end of which time the state had 41 rigs and 149 drilling wells. Cable tools are utilized for drilling tests in the state.



WEST VIRGINIA

Production, 1930—5,100,000 Barrels

Fifty wells were completed in West Virginia during the month of June. The state had 9 rigs and 31 drilling tests the last of the month. Cable tools are used by operators for making hole.

● Denotes oil and gas fields.

Figures on maps indicate average prices of crude oil per bbl.

NEW MEXICO

Production, 1930—10,235,000 Barrels

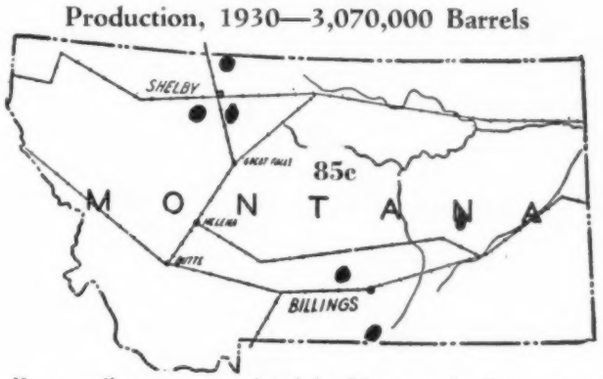
Activity in New Mexico continues to await the return of better markets. Operations within the state are at the lowest point since it arose to great prominence last year with the discovery of the Hobbs field.

During June there was but one well completed, there are only 4 rigs and 41 drilling tests in the entire state, the greatest number of which are at Hobbs.

Rotary tools are used in drilling the Hobbs field, where heavy upper gas pressures are encountered and demand heavy muds and tools for safely penetrating. Cable tools are used in many other parts of the state.

MONTANA

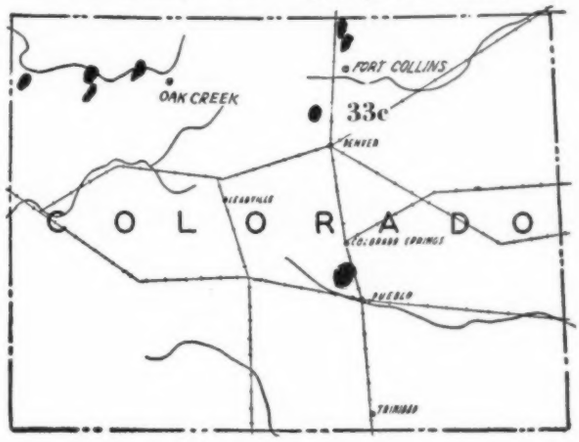
Production, 1930—3,070,000 Barrels



Four wells were completed in Montana in June, at end of which time there were 9 rigs and 58 drilling tests in the state. Cable tools are the most common means of making hole in the state.

COLORADO

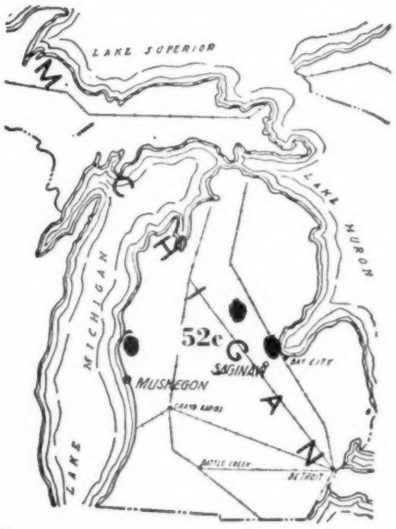
Production, 1930—1,644,000 Barrels



There were no completions during the past month in Colorado. Drilling activity consisted of 12 rigs and 65 drilling tests. Both rotary and cable tools are to be found operating in this state.

MICHIGAN

Production, 1930—3,525,000 Barrels



The state of Michigan had 4 completions during the past month. The state has an even 100 drilling wells, while there are 60 rigs.

Practically all of the wells in the state are drilled with standard tools.

● Denotes oil and gas fields.

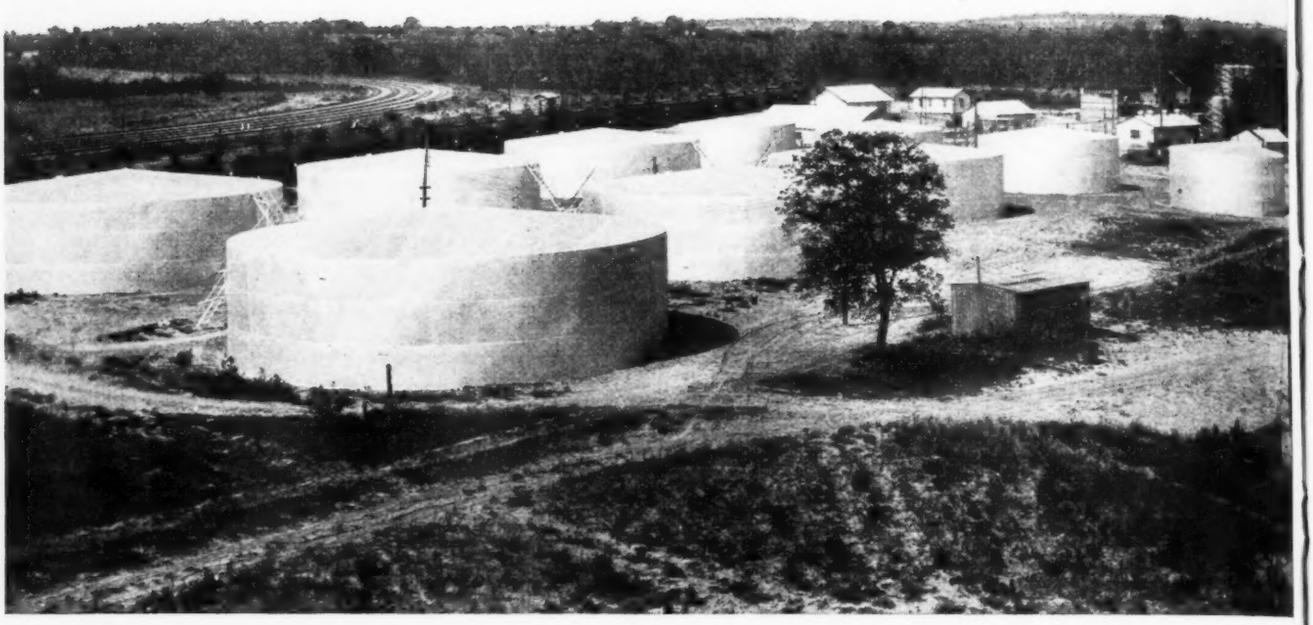
INDIANA

Production, 1930—1,000,000 Barrels

Indiana had 2 rigs and 49 drilling tests at the end of June, during which month it had 17 completions. Cable tools are employed by the operators for making hole in this state, where producing depths are shallow and easily reached.

Figures on maps indicate average prices of crude oil per bbl.

WELDED



Welding of field and refinery storage tanks without limitation as to size and without the use of rivets or bolts for fitting together the shell plates has been successfully developed by the WYATT METAL AND BOILER WORKS. In offering large welded tanks to the trade in which the tightness and efficiency of the welded joint is fully utilized, the Company believes it has rendered a real service to the purchaser.

The 75 units completed and under construction range from 500 barrels to 80,000 barrels and aggregate approximately one million barrels.

The type of joint used is either a lap

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STEEL TANKS

joint or a butt-strap joint, the welding specifications and the type and design of the joint being controlled by the joint efficiency required and the thickness of plates used.

Greater joint efficiencies available in the welded design combined with the practicability of welding lighter plates than can be joined in the riveted and caulked method importantly reduce the weight per barrel of the storage container. The lower first cost is obvious. A more important saving, because it is continual, is accomplished in the positive elimination of leakage and seepage and in lower maintenance costs. Continuous painting is unnecessary and corrosion attacking the rivets and caulked joints can not occur.

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Progress of Major Pipe Line Work

By J. H. DAMERON

GREAT LAKES PIPE LINE CO.

WELL into the final stages of construction, several of the major pipe line projects now being built are expected to be in operation throughout their entire length by late summer. As these projects go into construction history, others are being started. East Texas continues to be the most active area for pipe line work. Some of the lines emanating from that territory are major projects calling for the construction of arteries to carry the low-priced crude to tidewater on the Texas Gulf Coast.

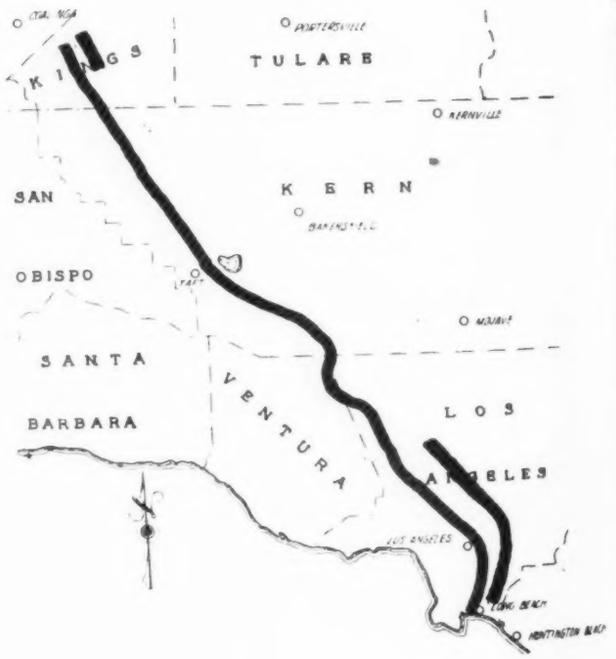
Both the Shell Petroleum Corp. and the Sun Oil Co. are building 200-mile lines from East Texas to the Gulf. Two other similar projects are hanging fire and one is expected to be started sometime in July. In addition, there is considerable short line work under way in East Texas. Numerous gas companies are busily engaged at the present time building laterals from main lines constructed last year, and considerable main line work is pending in the northwest, east and some in the southwest.

The Great Lakes Pipe Line Co., builders of an 8-inch and 6-inch welded gasoline line from the Mid-Continent to the Great Lakes region, has virtually completed all of its main line work. Only a relatively small amount of lateral work remains. The Diesel-powered, reciprocating pump stations all along the line are about ready for operation. Gasoline has been going through part of the line for several months and the remainder of the line is expected to go in service within a short time.

SOUTHERN FUEL CO.

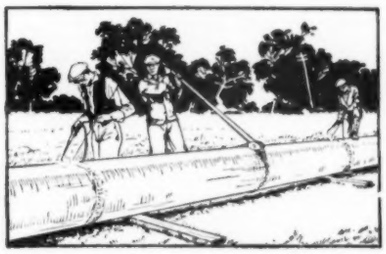
Southern Fuel Co., builders of a 185-mile, 26-inch welded gas transmission line on the Pacific Coast, has its construction work progressing rapidly. Approximately 46 miles of the line has been completed and is in the ditch. Work has been started at Castaic under contracts let to Southern California Construction Co. and Lang Transportation Co. for the building of 40 miles across the mountains. This section will be acetylene welded.

Spreads have been started out of Kettleman Hills by the Macco-Robertson Co., who were awarded the contract for laying of the line south from Kettleman. Welding Engineering Co. of Bartlesville, Okla., was awarded the contract for the electric welding of this section of the line. Field pressure will be utilized for the present to transport the gas from Kettleman to Los Angeles and Long Beach.



Indicates completed portion of line.
Indicates proposed route of line.

In the Mill and on the Firing Line



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IN construction of pipe lines in the field or double lengthing of pipe at the mill Linde Process Service can provide invaluable assistance in organizing welding operations for maximum speed, economy and dependability.

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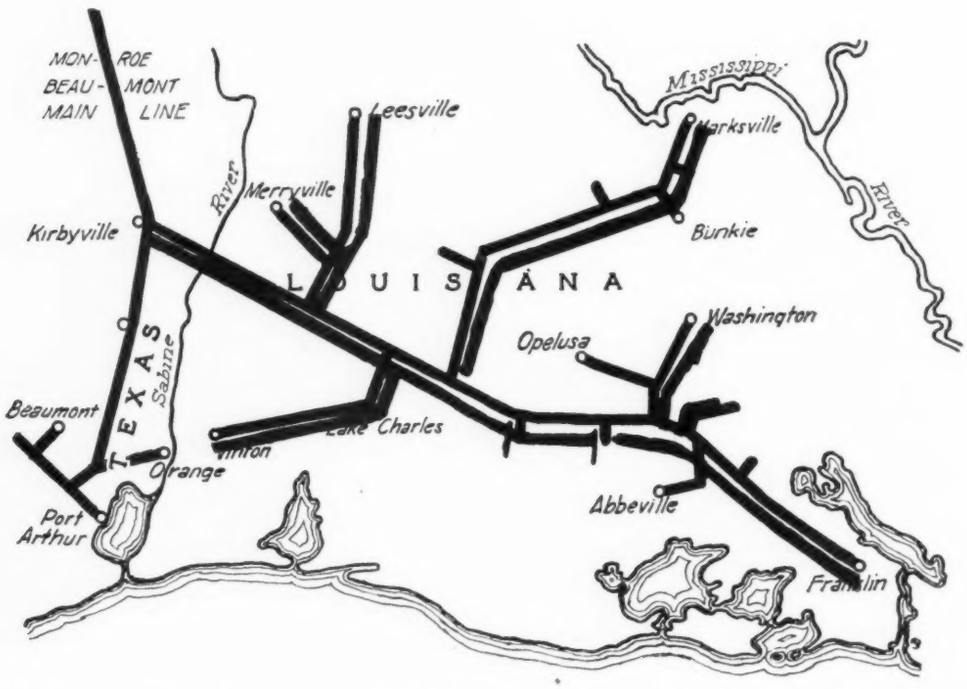
PANHANDLE-EASTERN PIPE LINE CO.

Panhandle Eastern Pipe Line Co. is rapidly nearing the terminal at Indianapolis, Ind., with its combination welded and coupled 24-inch, 22-inch and 20-inch line coming out of the Texas Panhandle. Construction work on the laterals in Missouri and Illinois is going forward at an equally rapid pace and the entire system is expected to be in service this fall.

When the line is completed it will probably tie into the Columbia Gas & Electric Co.'s vast eastern network, which would afford the Columbia system reserves from the Texas Panhandle and Kansas fields. The two compressor stations, both located in Kansas and equipped with five 1,000-horsepower units each, have been completed and are ready for service. A third station is under construction in Illinois.

UNITED GAS CORP.

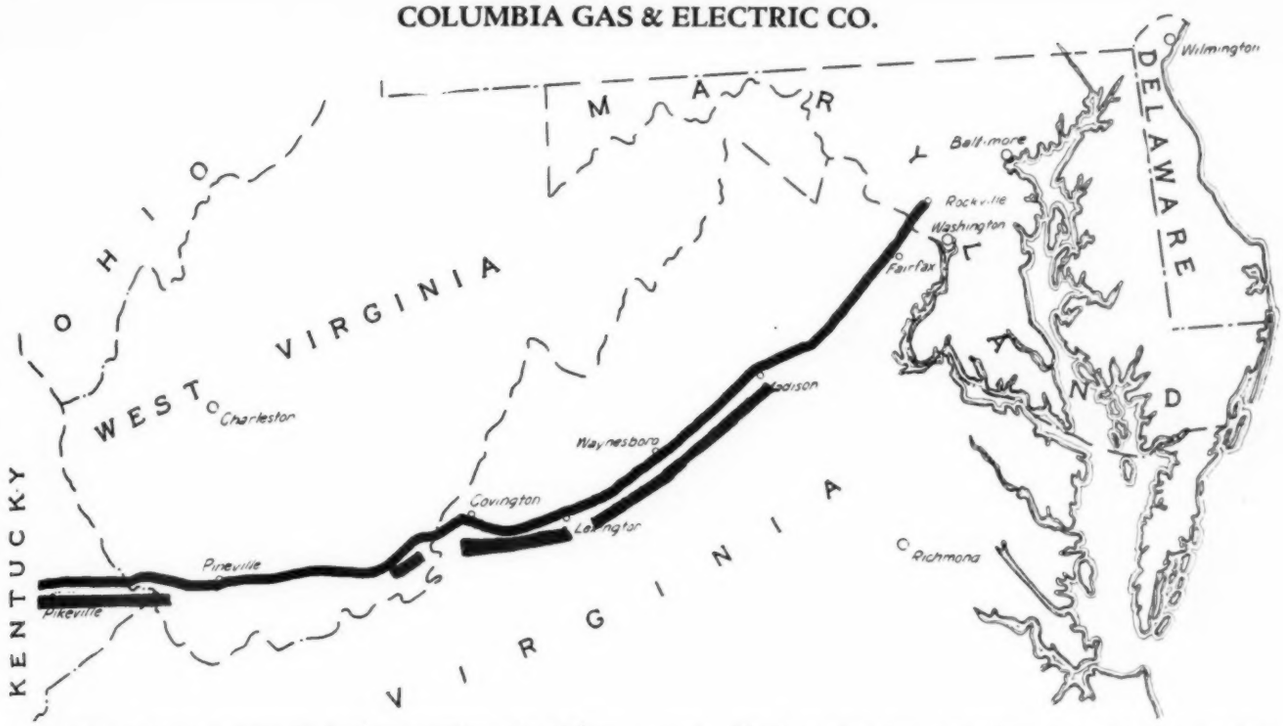


On the Gulf Coast the United Gas Corp. has completed its 420-mile main and lateral transmission system threading through southwestern Louisiana. This line was built through swamp country and rice fields, and during the spring of this year seasonal rains and high water greatly retarded the construction work.

The system ties into the United Co.'s main line coming down from the Monroe gas field in northeastern Louisiana to Beaumont, Texas. Additional compressor station capacity was installed at Kirbyville, Texas, the junction point of the two lines, to operate the Louisiana extension.

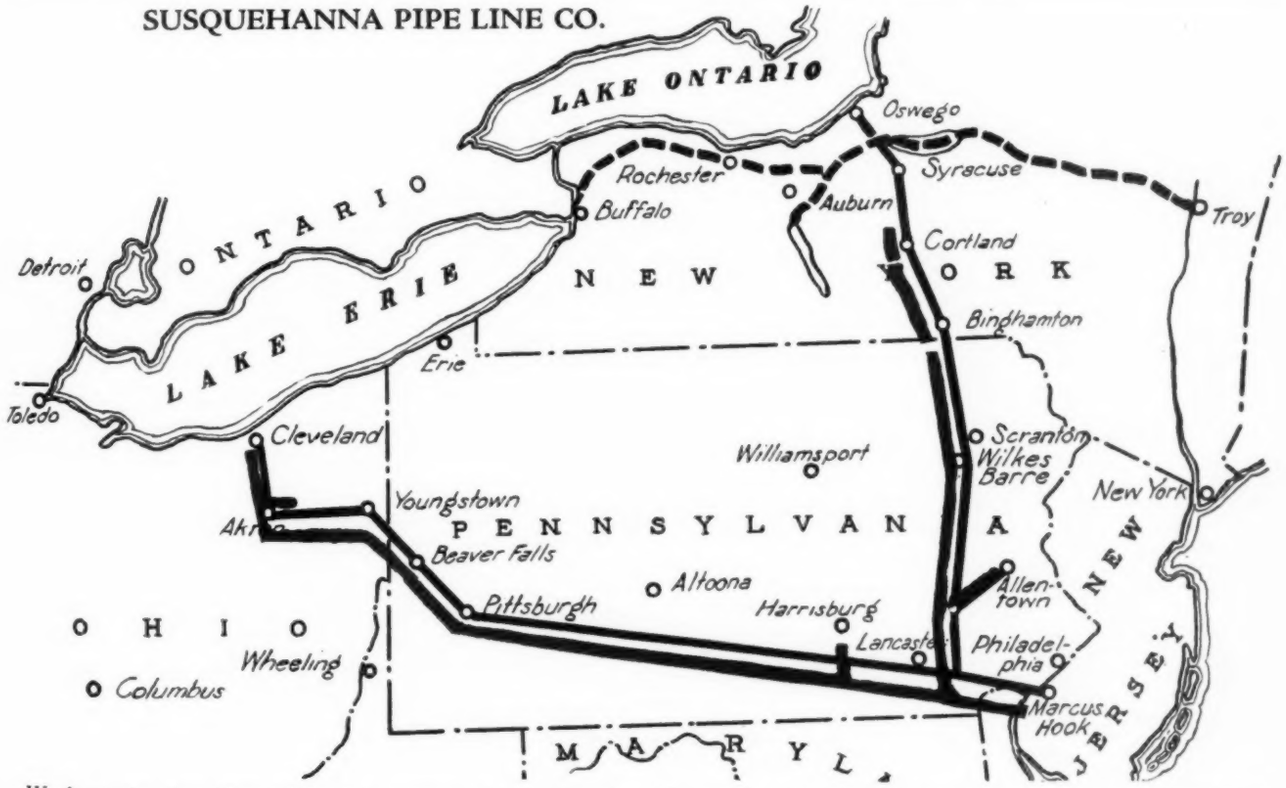
Indicates completed portion of line.
Indicates proposed route of line.

COLUMBIA GAS & ELECTRIC CO.



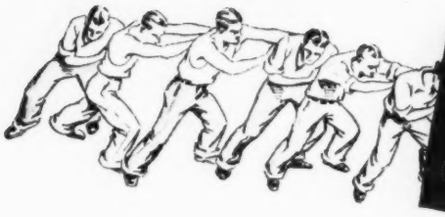
Working through extremely broken country, the Columbia Gas & Electric Co. is well along with the construction of its 350-mile combination welded and coupled 20-inch gas transmission line. A 20-inch line was built from the company's Pennsylvania system south to Rockville, Md., last year. Work on this line is broken up at the present time, but the various spreads, working in difficult country, are making rapid time. For the present one compressor station will be used to operate the line. This will be built at Eliza Forks and the work is getting well under way.

SUSQUEHANNA PIPE LINE CO.



Work on the Sun Pipe Line Co.'s eastern 6- and 8-inch welded gasoline transporting artery is in the final stages of completion. This line will be operated as the Susquehanna Pipe Line Co. in Pennsylvania and through subsidiary companies of the Sun Co. in Ohio and New York. The stations on the line are motor-driven centrifugal units. The only work remaining is the northern section of the line in New York state, and this is expected to be completed about August 1.

Indicates completed portion of line.
Indicates proposed route of line.



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Simply lay the tongs on top of pipe, hook chain around it, engage rearward teeth and push down.

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"Vulcan Boll-Weevil" was designed for pipe line and flat pipe work. It was named for the men who use it. This tongs simplifies their labor. Note the description at the left.

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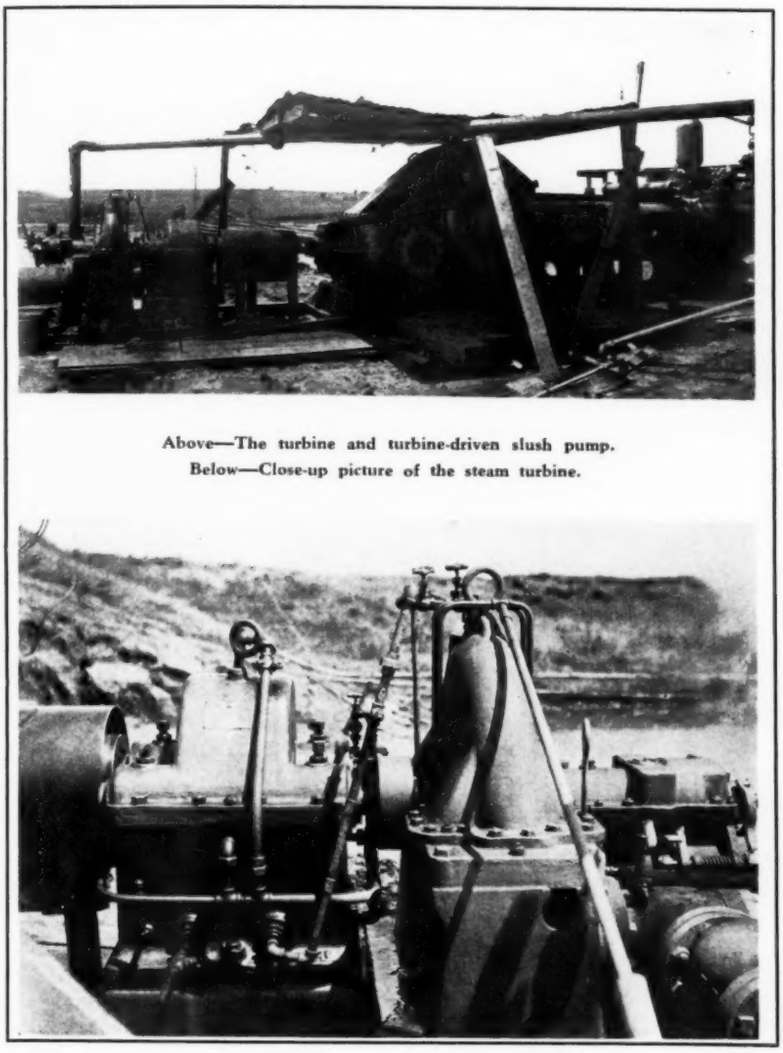
Use *of a* Steam Turbine-Driven Mud Pump New Rig Departure

A RADICAL departure from ordinary rotary drilling rig practices in operating mud slush pumps has been the installation and use of a steam turbine driven slush pump by the Magnolia Petroleum Company on its Dave Hoffman test, in Section 16-21-2W, seven miles west of Perry, in Noble County, Oklahoma. The turbine driven pump was readily accepted by the drillers, as well as by many others connected with the installation. Much valuable information was obtained from tests made on the unit under its actual working conditions, which showed it to have plenty of power and exceptional economy of operation.



Above—The turbine and turbine-driven slush pump.
Below—Close-up picture of the steam turbine.

The Hoffman test was recently completed at a total depth of 4,925 feet. No other new equipment except the turbine and power pump was necessary to make the change in the method of circulating the mud fluid, all of the present-day steam rig equipment being used as formerly.

The power pump was a Prescott 7x20-inch specially designed unit driven by a 250-horsepower steam turbine employing a working pressure of 650 pounds on the mud, based on 7-inch liners. The turbine was direct connected to the drive shaft of the slush pump. The pump was set up in the customary location and manner used on the ordinary Mid-Continent area rotary drilling rig.

This turbine driven slush pump installation was an experiment to prove by field tests the feasibility of such a drive. The simplicity of operation was an outstanding performance feature. Although a new piece of equipment, and the application a radical departure from previous methods, the crew needed no special instructions for operating the unit, nor did it require any special attention. Its operation was controlled by merely opening and closing a throttle.

Since the turbine was found to have a stalling torque of twice its full speed torque, it was possible to obtain a mud pressure of 1,200 pounds, with the turbine rotor standing still, and with only 230 pounds pressure on the boilers. If the pressure dropped slightly, the turbine moved the pump pistons just far enough to restore the normal pressure. Such a high pressure would be advantageous in working out a stuck bit, or for cementing. The ease with which any pressure up to the maximum on the fluids could be obtained and held by manipulating the throttle was a big feature, when the turbine stalled at 1,200 pounds, and the throttle was left wide open, it automatically held this pressure. It was furthermore found that since the torque of the turbine increased as it slowed down in speed it would handle any sudden increase in pressure on the fluids.

By metering the gas used under the boilers, it was learned that the total daily consumption for the entire rig was approximately 300,000 cubic feet. The water requirements showed about 800 barrels of water being needed each 24 hours operation, of which approximately 200 barrels were used for make-up water in the slush pits. Two 125-horsepower boilers were used to generate steam for all rig operations, including the turbine.

No attempt was made to reclaim the condensate available from the exhaust of the turbine, it being permitted to blow into the air, and since the steam used by the turbine is not contaminated with lubricating oil, it is ideal for boiler feed purposes.

The drilling committee of the A. S. M. E. has made some exhaustive tests on this well and will later issue data on steam consumption per horsepower, mud fluid pressures, gas consumed, etc.

Further units will no doubt attract as much attention from the engineering division of the oil industry, if not more, than the Magnolia's Hoffman well installation.

The Month's Activities *in* Refining*

By F. R. STALEY

REFINERIES in the Eastern and Central divisions operated at lower crude capacities than during the previous month, while those in the Western division increased about one per cent.

The Globe Oil and Refining Co. has established a new office in Dallas. The company is planning to erect two 10,000-barrel refineries, one to be located in East Texas and another one in Kansas.

The Danciger Oil and Refining Co. will build a 10,000-barrel plant near Longview, Texas.

The Sun Oil Company is planning extensive improvements in its various refineries.

Construction work is being rapidly pushed on the new 10,000-barrel refinery at Henderson, Texas, which is being built by the Central Refining Company.

The Pan-American Petroleum Co. has purchased land in Texas and may build a refinery at a future date.

The Gupeco Refining Co. has purchased and overhauled the Alexandria refinery at Alexandria, La. It is processing 500 barrels per day of Uranian crude.

The Apache Refining Co. has started operating its new refinery at Sunray, Texas. It has a 5,000-barrel capacity.

The Ethyl Gasoline Corp. will erect a new testing laboratory at Baton Rouge, La., to cost $35,000.

The new 10,000-barrel tube-and-tank cracking plant of the Associated Oil Co. at Avon has recently been put in operation. It was erected by E. B. Badger & Sons Co.

A 120-barrel skimming plant will be erected at Artesia, N. M., by Gray Coggin on the Grayburg Oil Co.'s lease.

Foster and Company will start operating their refinery at Denison, Texas. It has a daily capacity of 800 barrels, and will run East Texas crude.

The annual meeting of the American Society for Testing Materials, held at Chicago, was the largest attended of any in its history. The Symposium on the Effect of Temperature on the Properties of Metals was the highlight of the meeting. It was apparent that the subject is one of great interest and will continue to press to the fore where temperature influences the design of engineering equipment.

Natural Gasoline

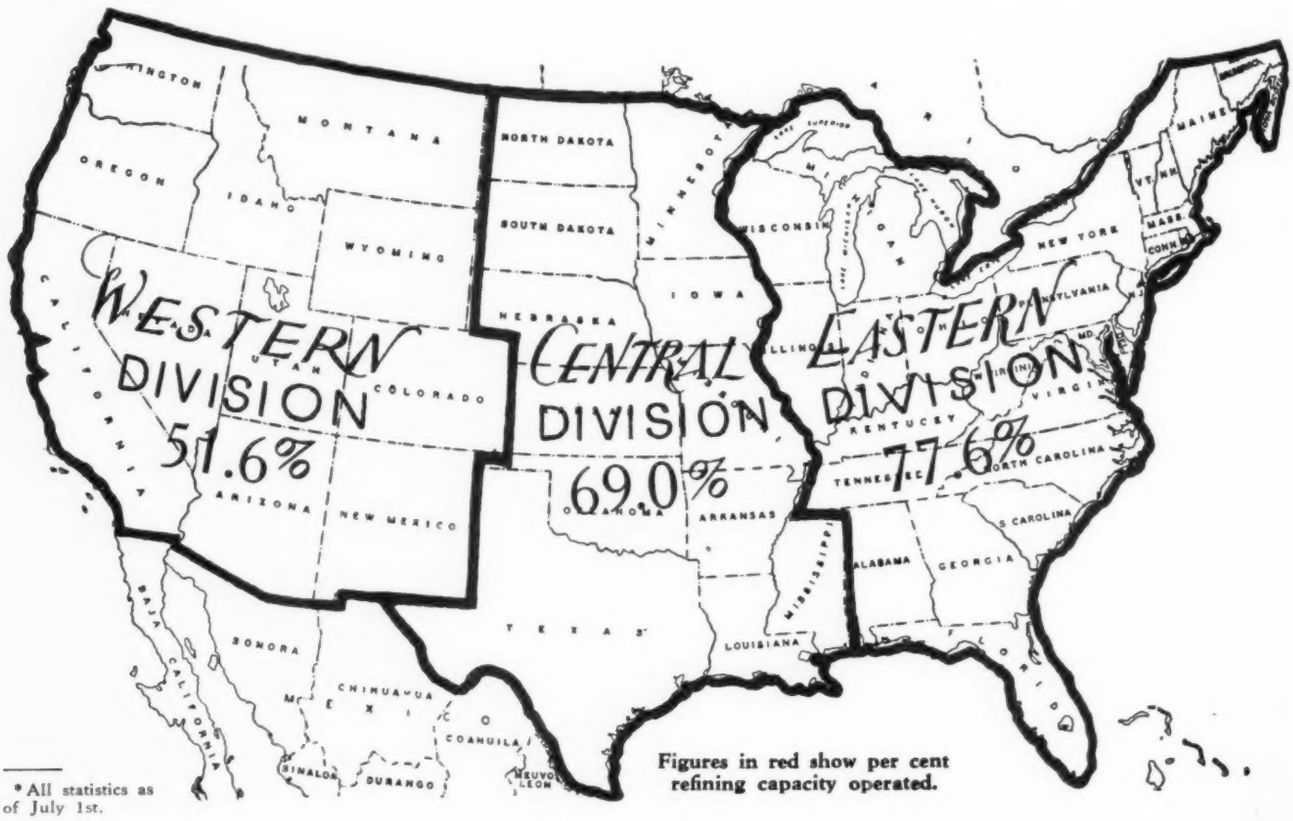
S. S. Smith, president of the Natural Gasoline Association of America, named the personnel of seventeen committees to serve for the coming year.

The natural gasoline output of Kettleman Hills, Calif., is steadily increasing. During May the output was over 371,000 barrels.

The natural gasoline plant at Van, Texas, is now handling about 12 million cubic feet of gas and produces about four cars of grade AA daily.

Cylinders of liquefied propane will be carried by the new U. S. dirigible Akron, ZRS-4, to be used for cooking meals.

The Carbonic Products Co., Inc., is building a six-ton plant at Tulsa to manufacture dry ice. The Girdler Process will be used to supply carbon dioxide.



Figures in red show per cent refining capacity operated.

* All statistics as of July 1st.

Economics *of the....*

EAST TEXAS FIELD

By B. A. CUNNINGHAM, JR.,
Engineer, Simms Oil Co.

THE economics of the new East Texas oil field is of interest to anyone connected with the oil industry and is vitally important to those directly interested in the region itself. It is particularly interesting to study the relation of proration and its effect on the economics of the field. The optimum well spacing and profit per acre for any pool are dependent on the factors of price of oil, lifting costs, costs of development, rate of decline, amount of royalty, and ultimate recovery per acre.

B. A. Cunningham, Jr.

The drainage factor varies in different pools and in parts of the same pool. The closer the wells are spaced the greater the recovery per acre, and W. W. Cutler, Jr., in his U. S. Bureau of Mines' Report No. 2270, found that the recovery per acre is empirically inversely proportional to the square root of the number of acres drained per well where there is interference between wells. Addison Young has combined the factors for well spacing and profit into two simple and convenient formulae. These empirical formulae can not be exactly mathematically correct as certain variable factors are treated as constants, though strictly they are not. However, the values assigned to the various factors must necessarily be estimates, and as a number of the factors are used in the formulae, an error in the estimate of one of the factors might not tend to throw the final result off very far. Also unless errors in the accuracy of values assigned to the factors tended to be cumulative in the same direction, they might tend to balance one another.

In this discussion three operating conditions are taken up: (A) Normal operations are assumed to take place, that is where the wells are allowed to flow open, or practically open, and the oil is taken out as fast as it can be disposed of; (B) Moderate proration in effect the initial years of production and the production curve held down and spread out over more years, assuming in this case that proration held the wells down to an average of about 250 barrels per well; (C) Extreme proration in effect where the wells would be held down to about 100 barrels of oil per day. When it is considered that probably 90,000 acres are proven up to the present time, it can be seen that this latter case of extreme proration limiting wells to 100 barrels per day can easily be reached or exceeded, particularly if close spacing is adhered to.

The following empirical formulae show the ideal spacing of wells and the net profit per acre:

(1) Ideal $n = \left(\frac{2\,C}{D\,E}\right)^2$ where E equals 3.16 P. A. (1-R-L)

(2) $Q = \frac{D\,E}{\sqrt{n}} - \frac{C}{n}$

In the above formulae the letters symbolize the following factors:

n—Number of acres drained by one well.

C—Cost of developing one well. Under this are assigned all costs not to be allocated to lifting costs.

P—Price of oil. Average estimated price of oil each year weighted according to estimated production each year.

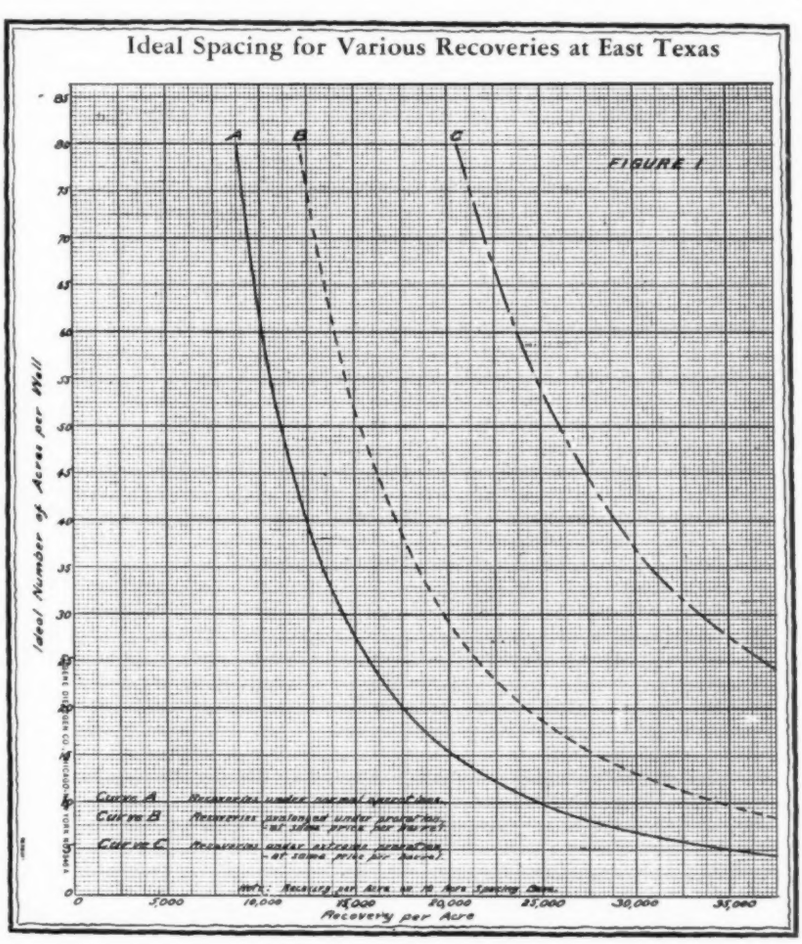
L—Ratio of lifting costs to price of oil. Under lifting costs must be assigned all costs not allocated under "C".

R—Royalty fraction.

Q—Net profit per acre.

D—Factor depending on decline. D is based on estimated decline and production produced each year, with the present value of the future oil discounted at a given rate of interest.

A—Recovery per acre, based on 10-acre spacing. If the estimated recovery per acre is based on any other spacing in any portion of the field, it can be referred to the base of 10-acre spacing on the basis that



recovery per acre is inversely proportional to the square root of the number of acres per well.

The three conditions of producing are considered as discussed above. In the above formulae this increasing severity of proration would increase "L", the fraction of lifting costs to price of oil, as the costs of producing the oil would be in effect for a greater number of years and therefore the total ultimate lifting costs would be greater. "D", the factor of decline, would also change under proration as more oil would be received in the future and therefore be worth less now when reduced to the present value of a future profit. In finding the values of "D", the present value of the future profit was discounted at 10 per cent. In this analysis the price of oil is first taken as being the same for each of the three sets of conditions, and it can then be seen what effect various price changes will have.

The following values were assumed for the formulae:

Normal operations: C is $25,000; P is $0.50; R is ⅛; L is 0.4; D is 0.850.

Moderate proration: C is $25,000; P is $0.50; R is ⅛; L is 0.5; D is 0.775.

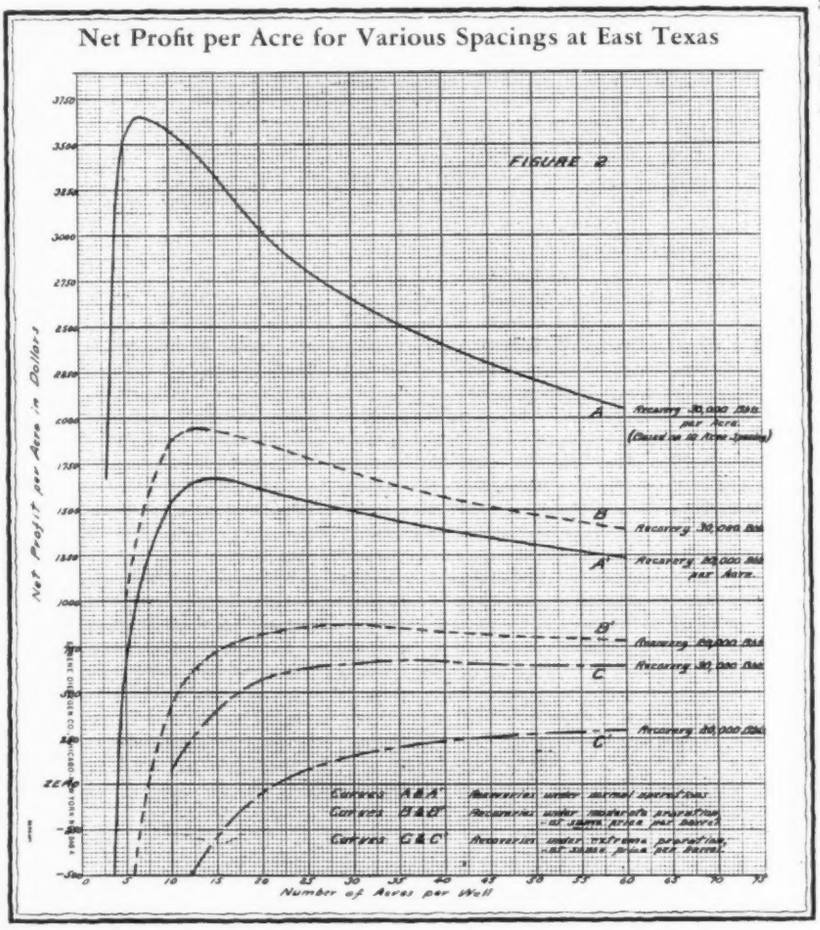
Extreme proration: C is $25,000; P is $0.50; R is ⅛; L is 0.6; D is 0.625.

Two sets of curves are drawn covering the three conditions: Figure 1 shows the ideal spacing in wells per acre for various recoveries, and Figure 2 shows the net profit per acre for recoveries of 30,000 and 20,000 barrels per acre.

Taking up Figure 1, it is seen that the more extreme the proration the wider the ideal spacing becomes. For example, it is estimated that from some wells already completed the recovery will be 30,000 barrels per acre with 10-acre spacing. (If the wells considered are on different spacing their recovery can be reduced to the 10-acre base to use on the curves by making use of the fact that the recovery per acre is inversely proportional to the square root of the number of wells per acre.) It can be seen from the curves that under normal conditions the ideal spacing would be one well to about seven acres, under moderate proration one well to 13 acres, and under extreme proration one well to 37 acres. It is of interest to note that this last ideal spacing comes very close to the 40-acre unit set up by the proration ruling for the Longview area. It can thus be seen that under proration the ideal spacing to get the maximum net profit per acre for a given recovery is greater than without proration, thus tending to prevent closer drilling and cutting down on the development costs.

Taking up Figure 2, it is seen that the more extreme the proration the less the net ultimate profit per acre for a given recovery at the same price per barrel. This, of course, is to be expected due to the increased total lifting costs as the lifting costs are in effect a greater number of years, and to more of the oil being received further in the future. However, it is possible under proration that higher recoveries may be obtained due to better utilization of the gas or by holding back salt water. Also under proration a higher price may be received.

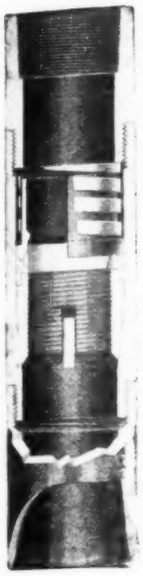
On the curves it is noted that there is a maximum point of profit for each recovery and set of conditions. These points occur, of course, at the spacing indicated as the ideal on the curves in Figure 1. Closer spacing than the ideal results in more oil being produced, but this is more than offset by the increased amount of development costs allocated to each acre. On wider spacing than the ideal, the net profit per acre falls off because more oil is left in the ground which more than offsets the decrease in development costs charged to each acre.



The curves of net profit per acre can also be instructive in deciding on spacing and results according to the conditions of the company. For example, assume the conditions of moderate proration and 30,000-barrel recovery are expected to hold. It can be seen on this and a spacing of 15 acres per well that the net profit would be $1,930 per acre. However, on a spacing of 30 acres per well the profit would be $1,700 per acre, or about 12 per cent less. Since development costs, though, are roughly directly proportional to the number of wells, it can be seen that by choosing the wider spacing the development costs would be cut about in half while reducing the net profit per acre only 12 per cent. Company conditions might be such that it might rather take a slightly less total profit and save considerably on development investment.

It is noticeable that on closer spacing than the ideal that the net profit per acre falls off much more rapidly than it does on wider spacing. Take for example normal conditions and 30,000-barrel recovery. It is seen that the ideal spacing is about 7 acres per well. If spaced 3½ acres per well the net profit per acre would be reduced from $3,650 maximum to $2,250. To reduce the profit to a like amount, however, by wider spacing, the spacing would have to be nearly seven times wider than the ideal or 48 acres per well. Due to this difference in slope from the maximum, it is generally much safer to space the wells wider than the indicated ideal, rather than closer, as some errors might have been made in estimating the values that will hold, which would tend to throw the true ideal point further out. If these errors in estimation

PERFECT PERFORMANCE



Releasing and Circulating Overshot

Releasing and Circulating Overshot

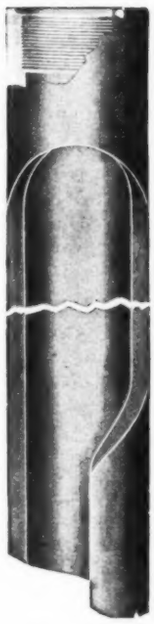
The thrill of Perfect Performance comes when a tool will take the place of two or three fishing tools, and will save time and trouble. American Overshots will catch drill pipe, coupling or tool joint. It releases from any point. The slips which are keyed in the bowl have left hand threads and the release is accomplished by rotating to the right.

The standard guide is interchangeable with the wall hook and milling shoe.

These features save many a run in and out of the hole.

When the fish is caught, the rubber packer makes a tight joint between the overshot and fish, this assures circulation.

You, too, may know the thrill of Perfect Performance when you use American products.



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Rugged construction and simple release mechanism simplifies the operation of the American Releasing and Circulating Spear, which means a saving in time and expense. Some of the special features of the American Spear is its hollow spear stem for fluid circulation. The releasing nut slides vertically on the stem and key. The box of the slip is threaded righthand to allow quick, easy release. The spear slip is a solid ring at the top end with lower part slit for expansion of the gripping section. The mandrel will rotate on the stem which minimizes friction in the releasing operation of the spear. Can be furnished with or without rubber packer for circulation.

Releasing and Circulating Spear

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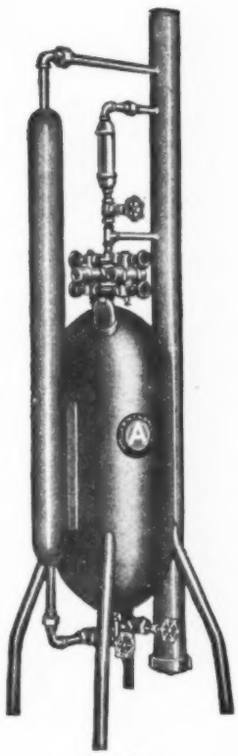
The new American Steam Lubricator affords capacity for more pressure and greater strength. Scientifically designed and developed. Equipped with two sight feeds so that one may be used while the other may be changed on account of broken glass.

When this improved lubricator is connected to Steam Header at the boiler, lubrication of mud pumps, engines and boiler feed pumps is assured at all times. Why not eliminate needless lubricators when one American will do the work of four ordinary lubricators. Capacity 12 gallons.



American Steam Lubricator

AMERICAN
IRON & MACHINE WORKS CO.
OKLAHOMA CITY, U. S. A.

MANUFACTURERS OF OIL FIELD EQUIPMENT

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did not occur, not a very large percentage of possible net profit would probably be lost by somewhat wider spacing than the ideal, but if they did occur, and in that direction, a nice profit per acre could easily be turned into a loss.

It is also noticeable that on the lower recoveries and profits that the tops of the curves become increasingly flatter, so that on these greater leeway is allowable to widen the spacing and cut down on the development costs without making much change in the net profit. The ideal point moves to the right for wider spacings as the curves of net profit for a given set of conditions moves down.

Spacings, of course, must also be regulated according to lease size and conditions and to offset conditions. Under proration the spacing selected must generally be also adopted to fit in with their rulings. For example, in the Longview area with 40-acre units, on a 40-acre lease no more oil could be produced by two wells than by one under proration. So ideal spacing must be modified accordingly. From the opposite angle, the unit to be selected for the proration ruling should be so selected that under the expected assumed conditions it will allow the operator to receive near the ideal profit per acre.

It is interesting to see just what price per barrel under proration would be necessary to equal the net profit per barrel without proration at 50 cents per barrel. Substituting, it is found that under moderate proration if the price is 58¼ cents per barrel, and under extreme proration 71 cents per barrel, that their curves of net profit per acre will equal that without poration at 50 cents. Likewise, for the net profit under extreme proration to equal that under moderate proration at 50 cents per barrel, its price would have to be 61 cents. The curves of ideal spacings would then also move together, as with better prices for oil it would become more important to drill closer and get more oil per acre.

Looking at it the other way round, if 50 cents is the price per barrel under extreme proration, how much lower would the price have to be under moderate proration or without proration before their curves of net profit fell to that of extreme proration. Substituting it is found that if the price under moderate proration fell to 41¼ cents, or without proration to 34.4 cents per barrel, the curves of their net profits would fall to that of extreme proration at 50 cents. Likewise, for the net profit without proration to fall to that of moderate proration at 50 cents, its price would have to fall to 42½ cents per barrel.

A moderate increase in price tends to increase the percentage of profit considerably. For example, on a recovery of 30,000 barrels per acre and moderate proration, the net profit per acre with 10-acre spacing would be $1,870 on 50-cent oil, while on 75-cent oil it would be $7,500 or about four times as much.

Thus it can be seen that it does not take a very large increase in price from proration to make it very much worth while to have proration. That it takes such a small increase in price is due to the fact that on the present low prices there is but little differential between costs and returns, so that a small increase in price means a relatively large increase in profit.

It is interesting to note the recovery per acre from the three other Woodbine sand pools that have been in for some time: Mexia 6.8 acres per well with estimated ultimate recovery of 25,000 per acre; Powell 3.1 acres per well with estimated ultimate recovery of 42,000 per acre; Wortham 2.3 acres per well with estimated ultimate recovery of 31,000 per acre. It is to be noted, however, that all these pools have been rather closely drilled, particularly in the case of the latter two. If the spacing had been wider the recovery per acre would have been less, but there would, of course, have been considerably less investment in development costs. If the pools had been drilled up on the basis of 10 acres per well, the expected ultimate recovery per acre might have been: Mexia, 20,600; Powell, 23,400, and Wortham, 15,000 barrels per acre.

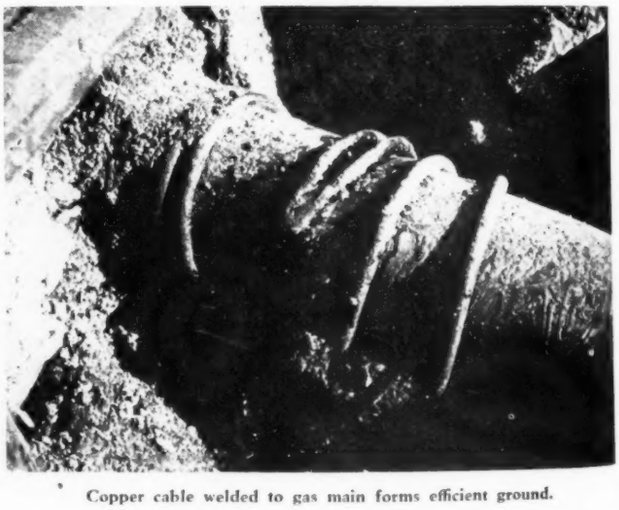
For Grounding Gas Lines

A PUBLIC utility company in the South recently installed one and one-half miles of 16-inch oxwelded gas main extending from the city gas plant to the plant of the electric light and power company. Expansion-type couplings were used at intervals on the line. As this main paralleled a high-tension transmission line between the two plants, it was thought advisable to bond across the couplings and to ground the gas line at several points.

In designing the grounding system a survey was made of methods used in this and related fields. It was found that in many cases, particularly in the electrification of steam railway systems, the problem of obtaining good electrical contact between steel and copper had been solved by the use of oxy-acetylene welding. In rail bonding, for example, the practice of welding the copper bonds to the rail by means of a special copper welding rod has given excellent results.

This practice is equally well adapted to the problem which confronted the public utility company, as it involves obtainining good electrical contact between the copper wires and the steel pipe.

In making the ground connections to the main, two lengths of heavy copper cable were wrapped around the pipe for several turns and the bare ends of the cable were bonded to the surface of the pipe, using a special copper welding rod. The other ends of the cables were tied in to the electric company's mitigating system. Two lengths of No. 4/0 solid copper wire were used to form the bond across each coupling. The ends of the bonding wires were welded to the surface of the pipe with the special copper welding rod. Since this welding rod has a lower melting point than steel or iron, the operation of bonding is quite similar to bronze-welding. The bond thus formed between the copper and steel has good mechanical strength and excellent conductivity, and experience has shown that it is highly efficient.



Copper cable welded to gas main forms efficient ground.

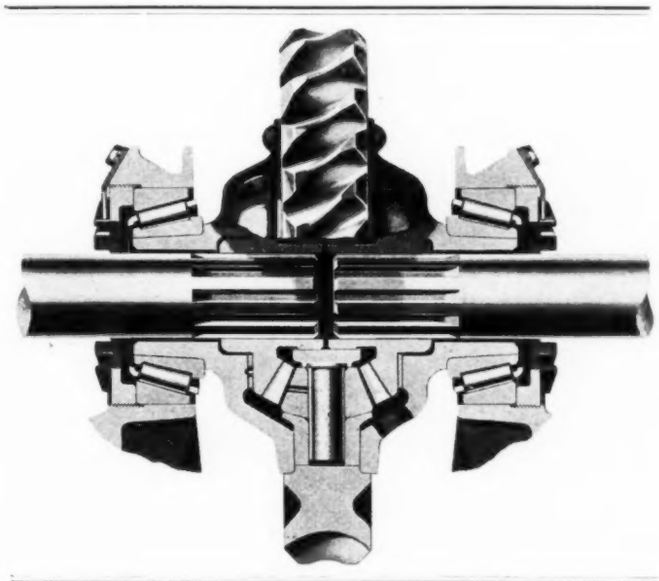
—Published by courtesy of *Oxy-Acetylene Tips.*

KEEPING *the* OIL FIELD TRUCK FIT *in* SUMMER

By **H. L. KAUFFMAN**, *Lubricating Engineer*

OIL trucks represent an investment well worth a careful monthly inspection at any season of the year, but this statement is especially true during the summer months when, generally, more mileage is covered and operating conditions are likely to be more severe than usual. Infrequent or casual inspections may mean a break-down when least expected and break-downs are costly, both from the standpoint of actual money expended for repairs and the loss resulting from the inability to transport the particular load.

Oil companies with large numbers of trucks in operation usually have their own shops, and executives of these companies have learned by experience that regular inspection of equipment is a paying proposition; further, that it pays to make minor repairs immediately when noted rather than to take a chance on "getting by" for another day, or two days, or a week. It is therefore to the individual operator or the hauling contractor with one or two or, perhaps, a half dozen trucks in use that this article is particularly addressed.



Cross-sectional view of differential mechanism as applied to truck axles—worm drive.

A truck—for inspection and overhauling purposes—can be looked upon as being composed of the following units:

1. Engine and engine-cooling system.
2. Electrical system.
3. Fuel system.
4. Power transmission and chassis parts.
5. Body and auxiliary parts.

As a matter of convenience, then, these units will be discussed in the order named.

Engine

If you haven't checked over your truck thoroughly since the beginning of Spring, it's almost time that you do so again, don't you think? Especially, if you should be one who is not "sold" on regular monthly inspections. From the power being developed by the engine, compared with what it has been giving previously, and the presence of the characteristics "carbon knock", you will probably be able to decide whether or not carbon should be scraped from the cylinders. *Excessive accumulation of carbon means that the engine will not and cannot function at its maximum efficiency.* Look over the valves. Do they need grinding and adjusting? Bear in mind that an engine cannot operate at its best if the valves are not properly seated and adjusted.

Go over the gaskets in the motor and stop all oil and water leaks around the attachments of the carburetor, hose connections, et cetera. Some oil filters have filter units that become full of dirt after about 10,000 miles of operation. If you have one of this kind, check this device to see whether or not a new filter unit is required. Don't neglect to clean the exterior of the engine at intervals. Kerosene is helpful in swabbing off accumulated dirt and grease. High-pressure steam is another satisfactory means. Several pounds of grime will be removed from the engines of many trucks by this operation. And by all means, tighten the engine in its frame every few months—even before there is any definite indication that this is necessary.

What oil shall you use? We'd suggest that on new trucks you follow the truck manufacturer's recommendations, increasing to a heavier grade as piston wear enlarges the clearance between ring and piston. But, don't use *too* viscous an oil, for too viscous an oil is more difficult to pump and that means more power is consumed. On the other hand, remember, too, that in summer your engine operating temperatures are higher than in winter and your oil must have sufficient "body" to provide adequate lubrication at the temperatures of operation.

Avoid the use of an oil with too high a carbon residue; in other words, *other qualities of the oil being equal,* give preference to the oil with the lower carbon residue. The problem of excessive carbon formation is not so great in summer operation of a truck as it is in winter, but it is always somewhat of a problem; and the use of a high carbon residue oil certainly does not lessen the problem—rather, it aggravates it. These so-called "carbon deposits," which are really mixtures of carbon, dirt, gum and metal particles, tend to build up on spark plugs, pistons, cylinder heads, around the rings, on the valves and seats and even in the crankcase itself. Such formations not only are a detriment from the viewpoint of ultimate power developed, but may also result in mechanical failures due to the inability of the lubricating oil to circulate properly by reason of clogging of grooves or oil ducts.

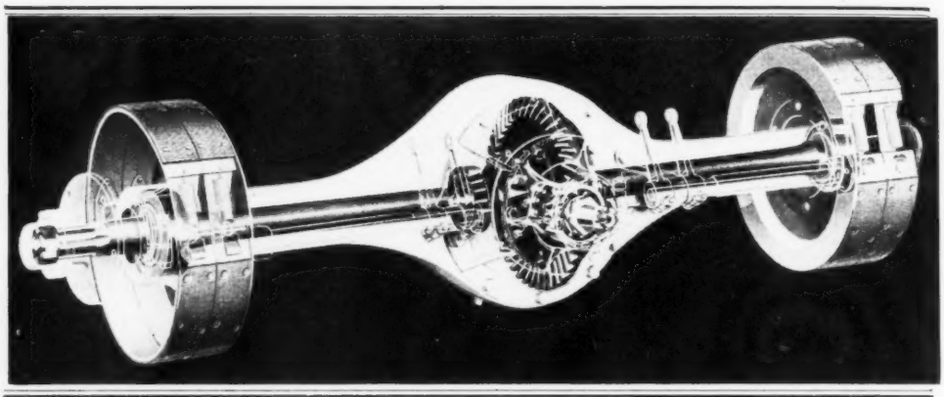
Engine Cooling System

In the ordinary use of trucks the cleaning of the cooling system about twice a year is all that is necessary. But oil-

field trucks are used under conditions that are far from "ordinary". Because the water that must often be used in trucks in oil service is dirty, contaminated, frequently highly alkaline, truck radiators need frequent cleaning; otherwise the scale that forms will interfere with the proper cooling of the engine.

Flushing of the system can be accomplished by pouring clean water slowly in at the top of the radiator while at the same time keeping the engine running, and letting it run out the opened bottom petcock. Wash the system in this way until a semblance of clear water comes out of the bottom outlet.

Sometimes no end of flushing will clear all the rust out of the cooling system, in which case a solution of ordinary baking soda—about half of a cupful to a gallon of water—should be poured into the radiator, the bottom petcock shut, and the engine kept running with the spark retarded until the water boils. Thereafter, the spark should be advanced and the engine kept running for about 15 minutes, after which the soda solution in the cooling system should be drained off, the system flushed and the radiator then filled with clean water.



Phantom view of bevel gear axle.

Another recommended procedure involving the use of soda in cleaning the cooling system is to dissolve two heaping handsful of soda in a bucket of boiling water and pour this mixture into the drained radiator. Let stand a half hour, then run the motor for five minutes and drain. Fill the radiator with fresh water and again drain. Repeat this latter operation three times, so as to be sure that all traces of soda have been removed from the cooling system.

When certain kinds of water are used in radiators, lime will be deposited along the walls of the cooling jacket and in the radiator pipes. When such lime accumulations are present, or rust is so thick that even baking soda will not remove it, then pure muriatic acid—about a quart to three gallons of water—can well be used as a cleansing agent. In the use of acid for removing scale the engine should be run with the spark retarded until the solution boils, after which the spark should be advanced and the engine kept running for twenty minutes. Then the system should be drained and be flushed thoroughly with fresh water. It is good practice, when acid is used, to repeat this process, employing baking soda in order that the acid may be neutralized. As aforedescribed, the baking soda solution should then be drained off, the system flushed and new water put in. It is very important that scale and rust be removed from inner radiator surfaces, as otherwise the truck owner will face the hazard of holes being eaten through the metal and radiator leaks resulting.

When inspecting the truck, look over the radiator for evidences of a leaky condition. If a leak should be noted, no matter how small, it is best to have the hole soldered from the outside. Often soldering alone will not prove adequate, and a new pipe must be inserted. Use of a liquid solder or similar "dope" is not to be recommended for making a permanent repair of a radiator leak, since there is considerable possibility of plugging up the entire radiator with the "dope" and hindering the circulation of the water. If there is a leak in the water jacket, letting rust accumulate at the leak will sometimes serve to stop it. If there is a crack in the wall, however, the only way in which it can be fixed is to have the jacket welded. Such cracks are likely to have resulted from overheating of the engine.

Don't forget to look over the fan belt and hose connections. If the fan belt is badly worn or stretched, it should be replaced. If necessary, replace worn rubber hose, making sure, too, that hose connections are in good condition.

Electrical System

Regular attention to the electrical system of your truck will save you grief at some future time. Clean and adjust spark plugs. Cleaning can be accomplished by removing the plugs, taking them apart, washing them in kerosene, gasoline or an ammonia solution and scraping them. The points should be checked for condition and clearance and, if they are found to be burned badly, new plugs shou'd be substituted. Check your generator charging rate, to be sure you are not overcharging your battery. Inspect the battery carefully. Clean the corrosion off the battery terminals with a little soda solution and water and, when the terminals are clean, coat them with vaseline or grease. Replace the battery cable if it is excessively worn or corroded. Adjust ignition timing; inspect lighting and ignition switches and relays; smooth up the starter brushes and commutators and examine the starter brush springs for tension; clean the distributor cap and ignition distributor points; and, lastly, inspect and adjust all lights.

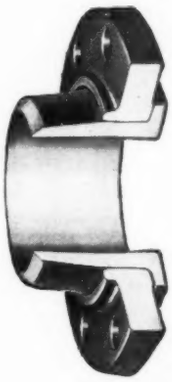
Fuel System

Don't forget that the engine fuel system needs regular cleaning. This can be done by opening the pet-cock or plug at the bottom of the fuel tank and draining off all gasoline. Then disconnect the line leading to the vacuum tank (if your truck utilizes the vacuum feed) and blow it out with a pump. Drain the vacuum tank through the bottom of the pet-cock. Remove the feed line leading to the carburetor and clean it either by air pressure or by running a wire through it. Take out the strainer at the bottom of the carburetor and wash it in kerosene or gasoline to remove dirt and dust. The carburetor float, float valve, stem and float valve weights should be inspected as to wear and tear. The carburetor body and spring chamber should be cleaned and the spray nozzle blown out. It is also advisable to inspect for air leaks at the carburetor connections and where the intake connects with the cylinder block. Adjust the carburetor to give the most efficient mixture for the particular grade of fuel you are using and the temperature and altitude conditions under which most of your trucking operations are carried out.

The Perfect Application of a Principle

Nordstrom Valves on large compressor station operated by a gas company in Texas

NOT merely lubricated valves — but Nordstrom Valves with "Sealdport" lubrication. Nordstrom is the pioneer valve. It made possible the adoption of the plug cock principle to large as well as small sizes and for high and low pressures. Then came "Sealdport" lubrication—the latest Nordstrom development that places these valves still further ahead. This patented valve lubrication provides a complete lubrication seal around both inlet and outlet ports, thus effectively preventing leakage through the valve or to the exterior.



The "Merco" pipe joint flange, illustrated to the left, is also a product of Merco Nordstrom. It offers several unusual features. Sizes 1½" to 10".

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Power Transmission and Chassis Parts

If you haven't changed the grade of lubricant in the transmission, differential and universal joints over what you used during the winter months, it is advisable to do so, employing a grade heavier than was then utilized. Adjust and repack rear-axle bearings. Since the conditions under which the front and rear axle bearings function are somewhat similar to the operating conditions in existence with the universal joints, ordinarily the same kind and grade of lubricant can be used for the lubrication of these particular bearings as is employed on the universal joints.

On the front and rear wheel axle bearings, abnormal wear may occur in consequence of the lubricant's being thrown off from the wearing surfaces by the action of centrifugal force. A number of indications are given that such unusual wear of these bearings of the truck is taking place: For example, steering may be found to be more difficult, due to the wobbling of the front wheels; undue wear may be shown on the threads of both front and rear tires; or abnormal wear may be taking place on the differential gear teeth in the rear end—all indications that the front and rear axle bearings of the truck are not being properly lubricated.

In Timken front axles, especially designed for mounting front-wheel brakes on trucks, tapped holes are provided in the steering knuckle yoke bosses for knuckle-pin lubrication. Oil seals of improved design protect the pin and bearing from dirt and water, and also serve to retain the lubricant. Lubrication of the wheel bearings is readily accomplished through a tapped hole in the hub or hub cap. Adequate oil seals keep out dirt and water and retain the lubricant. A tapped hole in each end of the steering cross tube provides a means of lubricating the ball and ball seats. The manufacturers of Timken axles state that their experience has shown that nine-tenths of any troubles with Timken axles can be traced to lack of lubrication.

Remove all muck and grease off the chassis beneath the body, a thing that can be done when the body itself is being washed. Grease all joints. See that none of the grease nipples is clogged. More harm can be done by one clogged shackle bolt than with a hammer! Go over your steering apparatus. Remember that rough roads tend to increase the side thrust on the wheels and may put the steering mechanisms out of order; also, that ruts cause excessive wear of the knuckles and of the wheel bearings.

All shackles and spring clips should be tightened. Worn shackle bolts and bushings should be replaced. Replace felt washers where necessary. Examine all bearings everywhere, adjusting them when they need it, and seeing to it that they are properly lubricated. Clean yoke pins, bushings and steering connections. Inspect, lubricate and tighten wheel hub bolts. Replace all worn parts of the steering mechanism, and clean and adjust all others, including the steering gear housing, which should be repacked when lubricated. Inspect the clutch and lubricate and adjust its collar.

Have the brakes adjusted to an equal tightness on each side, relining them if necessary. Check up the alignment of the wheels of your truck, for uneven alignment will result in excessive wear on tires. And don't forget the tires themselves, especially since pneumatic tires are now being widely used on trucks. Check your tires, making sure that they are in good condition and properly inflated. Oil the windshield wiper and, if necessary, replace the rubber of the blade. And look after the condition of such other auxiliary parts of your truck as you feel warrant your attention —for example, the air springs.

Two makes of air springs are widely used on trucks—Gruss and Westinghouse—both employing oil in combination with air as a shock-absorbing medium, their purpose being to absorb the shock and vibration from the road that is so detrimental to the chassis and body of the truck. But air springs will not function without ample lubrication. In the case of Gruss air springs provision is made for sufficient lubrication by having two oil pockets on the side of the housing, said pockets holding nearly a pint of oil. In these oil pockets there is a felt wick that feeds a circular felt ring within the housing, which ring, in turn, supplies lubrication to the sliding sleeve. In addition to this, there is a large oil cup on the rear of the housing which should be filled with oil either daily or at the end of each 300 miles of operation. The grade of oil to use will depend upon weather conditions, but in summer a good grade of medium motor oil should be used. On Westinghouse air springs a light grade of lubricating oil should be injected into the hole cups and holes after each 200 miles of operation. Should the truck stand idle for any length of time, it is advisable to lubricate the springs before putting them in service, regardless of the mileage. Follow the manufacturer's instructions, and use the oil he furnishes or recommends, when it becomes necessary to re-prime the air springs.

Avoid Over-Lubrication

The rubbing parts of the truck demand lubrication, but use of too much oil or grease actually may be detrimental to the efficient operation of the truck, in addition to the economic loss by wastage. In lubricating the various chassis parts equipped with pressure fittings, a good practice to follow is to force new lubricant into the bearing until the old grease has been expelled; in other words, until new grease appears at the outer ends of the bearing. However, be careful too much new grease does not appear or, as in the case of the fan bearing, grease may get onto the belt and cause the fan to slip. Wheel hubs, steering gear shaft and distributor are other points where an excess of grease may cause trouble. Too much lubricant, especially use of one that lacks adhesiveness, on the wheel hubs may result in inefficient braking, since the grease may find its way beyond the felt retainers, ultimately to come in contact with the brake fabrics, or act as a lubricant between braking surfaces. This is very likely to occur where front wheel brakes are employed. In the case of the steering-gear shaft, grease used in excess will work out at the top of the shaft; with the distributor, the points may become fouled if too much lubricant is applied on the shaft for penetration into the distributor.

For efficiency in the operation of a truck the importance of inspection at regular intervals, certain parts daily, others weekly, the whole truck monthly, and of proper lubrication, cannot be too strongly emphasized. And while lubrication is a very important factor in the life of a truck, likewise must be kept in mind the dangers of using too much lubricant on certain parts. Lubricate, but avoid over-lubrication.

SUBSURFACE ENGINEERING

in the Completion *and* Production *of* Oil Wells

By P. S. HAURY, *Petroleum Engineer*

THE earlier petroleum engineers devoted much attention to subsurface studies and their application to the completion and repair of oil wells. This followed from the fact that many of them were connected with conservation agencies. With the greatly increased attention to the mechanical features of production, the importance of a complete knowledge of the conditions that obtain in the natural reservoir is not always appreciated. This knowledge is essential to the proper completion of wells—both in drilling the productive zone and equipping the wells for production.

It is generally understood that the producer is dependent on two natural expulsive forces to expel the oil from the containing rocks into the bore hole. These are (1) the pressure exerted by the expansion of the gas contained in the reservoir, whether this be free or dissolved in the oil. (2) The pressure exerted upon the oil by the hydrostatic head of the water that is in contact with the body of oil in the same reservoir. This latter is not always present, but is a considerable factor in most fields.

To utilize these forces to the greatest advantage it is essential to know the exact position of (1) the several oil-bearing strata and the impervious strata that enclose or separate the several pervious strata; (2) the location and extent of all waters in and adjacent to the reservoir—both edge waters, that are contained in the same strata with oil, but down dip from the oil, and waters that are separated from the oil-bearing strata by impervious partings. (3) The part of each porous stratum that contains mainly gas. Other essential facts are a knowledge of the degree of permeability of the several porous strata (this can be measured by the rate at which they yield fluid) and the natural pressure exerted on the fluid in each stratum. This knowledge is essential for determining the proper location of casing seats and proper completion depths.

With the general improvement in drilling technique much valuable data are collected, such as porosity studies and other information obtained from cores that are imperfectly utilized. Subsurface correlation of all data regarding the productive formation should start with the drilling of the first wells so as to make information gained locally applicable to the whole field as early as possible. Early application of such knowledge to the entire field will usually result in profit to all the operators as every lease is more or less affected by the general practice that obtains in the field. The correctness of this statement will appear from examples cited later on. These are drawn largely from published reports.

It would seem that such work could be carried forward to best advantage by one agency for the whole field, supported by all the operators and employing men trained in subsurface work applied to the special problems of development and production. Few companies can afford to assign men to these special problems. Where they do, there is duplication of work, as each must work out the subsurface

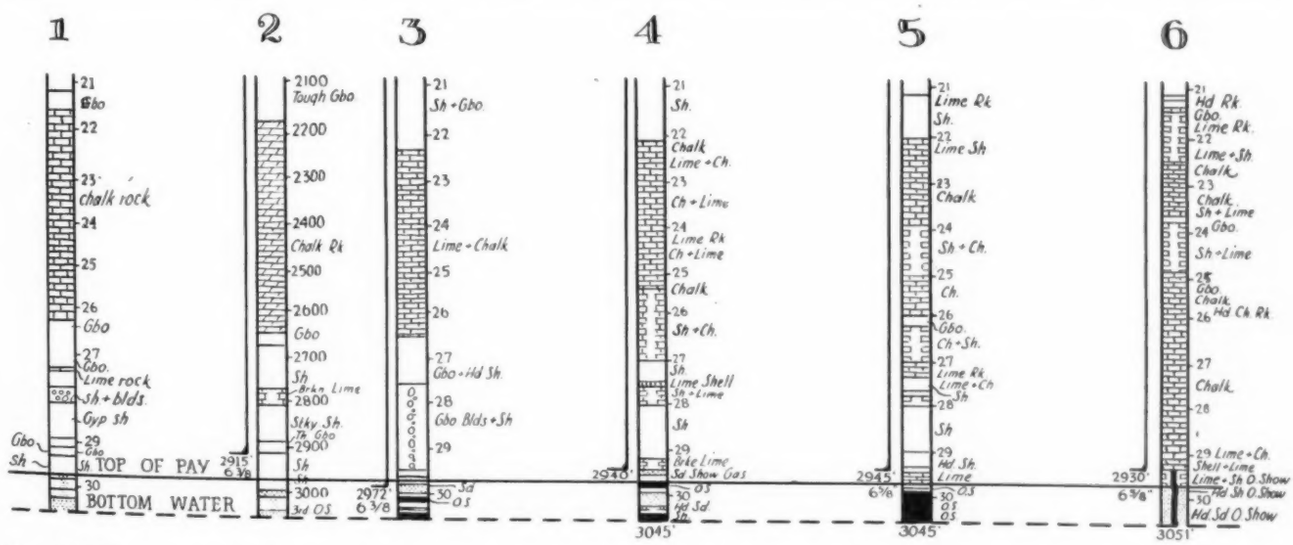


Fig. 1

relations of a large part of the field correctly to control the development on the leases for which he is responsible.

Most companies have assigned the selection of casing seats and completion depths to the geological department, which is mainly occupied with duties of an entirely different nature. The geologist's training is entirely in the line of exploratory work and he is principally concerned with such work. His methods are admirably adapted to the work with which he is mainly occupied. He seldom has the time or opportunity to study drilling and production problems—a knowledge of which is essential to the proper direction of the completion of wells.

The productive performance of wells already drilled should be used as a guide in the completion of later wells. The writer has found it very helpful to assemble the production data (gas, oil and water production) and all other pertinent facts on well log cross-sections. These data, along with the completion depths and casing depths, shown graphically on the sections, are usually sufficient for mapping definitely the several strata in the productive zone. Early wells are usually completed at different depths in the pay zone. Careful correlation of these will sometimes indicate the position of the more permeable strata. Much information regarding the rates at which the several strata yield fluid can be obtained with the formation tester. Recording pressure gauges that can be run into the well on a line have recently been developed. Such instruments can be used to determine the fluid pressures in the several porous strata.

It is essential to learn the productive characteristics of each pervious stratum in the oil zone early in the drilling campaign and apply this knowledge in governing later completions. Where a thick oil zone or several sands underlie a field, the temptation is always present to open up the whole oil zone in every well. Frequently better results would be obtained if this were not done. Thick sand bodies are seldom uniform in texture. Some strata will be more pervious and will yield oil more rapidly than others. Again some strata may be under lower pressure than others. These will take oil from the wells until the pressure in the first has declined to the point where the pressures in the several sands are equalized. In this case, higher total recoveries will be obtained if the lower pressure strata are cased off until the pressure in the high pressure sand has declined to this point.

The writer has knowledge of several cases in which such thieving by lower pressure sands was proven. A case in one field comes to mind, where there was an upper sand about thirty feet thick separated from a thicker sand zone underneath by a shale break. The lower sand was under lower pressure and yielded oil three degrees A. P. I. lower in gravity than the oil from the upper sand. Most of the wells were drilled into both oil zones. One company noted that a well, which did not enter the lower zone yielded the highest gravity oil and was one of the largest wells. The production from one of the other wells increased 300 barrels per day on plugging off the lower zone. The gravity was raised also. This company then increased the production from all its wells by plugging them back to the upper sand. Thick oil zones sometimes contain water sands under lower pressure than the oil sands. The water then does not appear in the production until the working pressure of the wells has declined to that of the water-bearing sand. If the water happens to be in an intermediate stratum, it is usually a tedious and expensive job to locate its position and entails expensive repair work, after it is located, to exclude the water from the wells. Correct procedure in drilling a thick oil zone is to test each stratum separately—learning its fluid content and its pressure. Usually it will be unnecessary to set a string of casing for each test. Much can be learned by the proper use of the testing tool. Also by correlating wells drilled to different depths into the producing zone. If there is much difference in the productive characteristics of two parts of the zone, the plane of separation should be located and subsequent wells should be restricted to one part or the other of the oil zone.

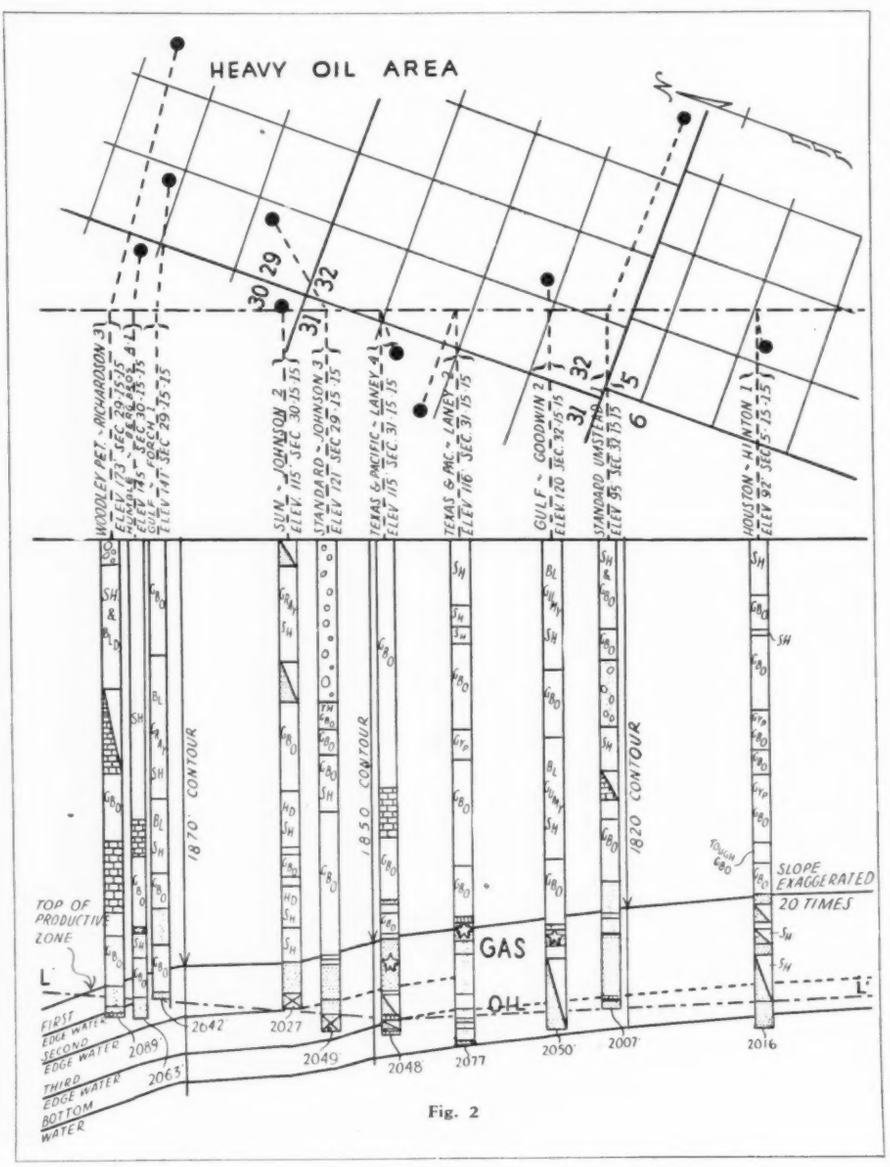


Fig. 2

found in many wells. It still is commonly assumed that the contact between oil and water in any oil field is a level plane. This would be the case in a thick oil sand that had uniform texture and permeability throughout. That, however, is the rarest occurrence in oil fields. An oil-bearing zone usually consists of several porous strata, each with a different degree of permeability. These are usually, though not always, separated by impervious strata. Because of differences in permeability, the oil accumulation is greater in some porous strata than in others, so that each of these has a separate edge water and the several edge water lines are located at different positions on the structure. Well log cross-sections are especially adapted to working out the positions of these several waters. Illustrations of such work are cited in the following paragraphs.

Figure 1 is one of a number of such sections used (by engineers of the U. S. Bureau of Mines) in working out the position of the water in the Fish Pond area of the Mexia field some years ago. The water was found to be bottom water for nearly the entire area, although this water-bearing sand contained oil in a very small area at the highest structural position of the part of the field studied and originally contained oil under all the higher parts of the Mexia structure, so that, considered for the entire field, it was an edge water.

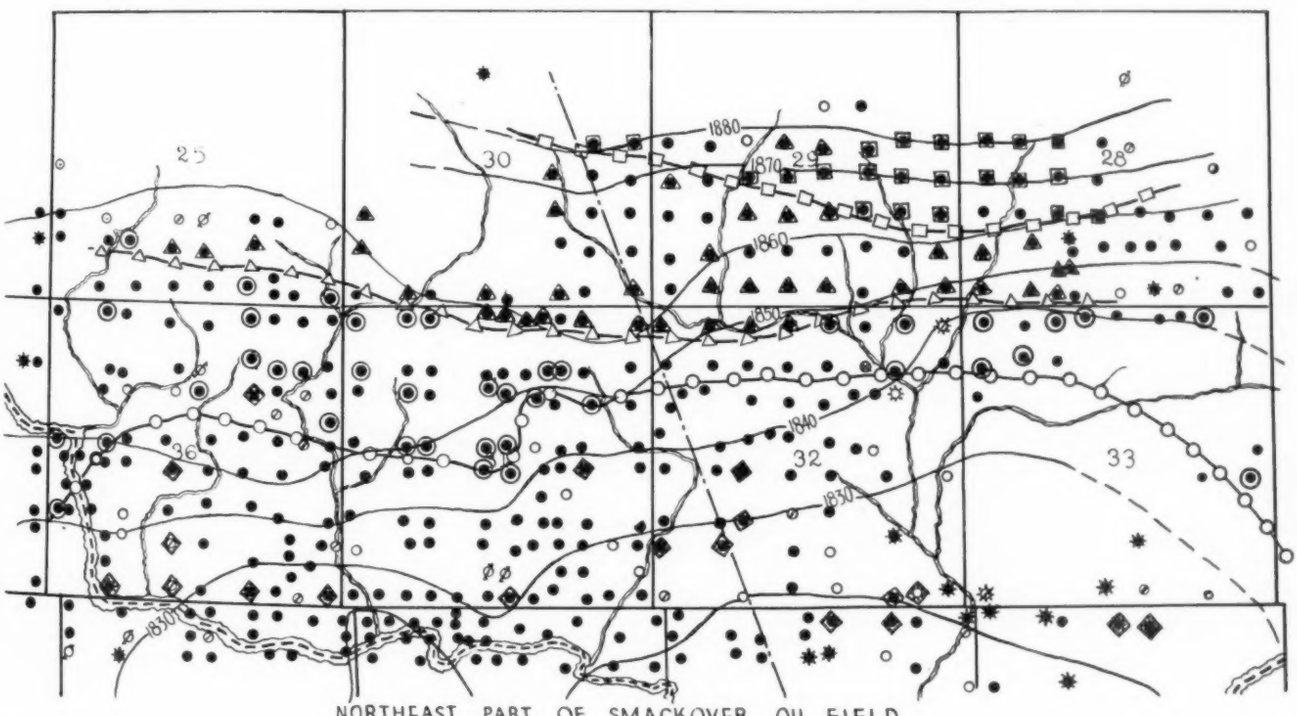
The water had been logged in only one well in the entire area studied. A shell above the water-bearing stratum was logged in a very few other wells. It was necessary, therefore, to locate the position of the water by checking water production against well depths, as shown on the cross-section. Thus, wells Nos. 4 and 6 had entered the water-bearing stratum, while wells Nos. 3 and 5 had not. Accordingly, the water line was drawn so as to touch Nos. 4 and 6 but not Nos. 3 and 5. The line at the top of the productive sand parallels this water line. Well No. 1 evidently was drilled deeper than logged. All the wells in the area studied were connected by cross-sections in this way and the water-bearing stratum was mapped according to the subsea elevations determined on these cross-sections. Well temperatures and water analyses served as a check in this field.

The water was plugged off with cement in almost all these water wells, and the wells were returned to profitable production. The plugging checked this correlation. In every case the water was shut off by bringing the cement plug up to only a few feet above the depth of the top of the water stratum, as indicated by the correlation.

The Woodbine sand is highly variable in this field and contains strata of caving shale. The perforated liner was pulled before plugging the first well but this proved to be costly as it took weeks to clean the hole out so the cement could be placed on bottom. Thereafter the liners were left in. The cement was introduced through tubing, under pump pressure. Then the tubing was raised to about three feet above the desired depth of the top of the plug and the excess cement was circulated out. The cement was successfully bonded with the wall of the hole, through the perforated liner, in this manner.

Figure 2 is a similar cross-section across the northeast part of the Smackover field. Figure 3 is a subsurface map of this part of the field, with structural contours at the top of the Nacatoch sand and with lines showing the upper limits of several edge waters that were mapped. A large number of wells were drilled into one or another of these edge waters. The well symbols indicate which one of the waters. The figures are from the work of the U. S. Bureau of Mines carried forward while the field was being drilled in 1923.[1]

[1] Preliminary report on the Eastern Part of the Smackover, Arkansas, Oil and Gas field—By H. W. Bell, P. S. Haury and R. B. Kelly—Arkansas State Bureau of Mines, Manufactures and Agriculture.



NORTHEAST PART OF SMACKOVER OIL FIELD
Subsurface Contours at Top of Nacatoch Pay

Well drilled into first edge water at 20 feet below top of pay.
Well drilled into second edge water at 42 feet below top of pay.
Well drilled into third edge water at 72 feet below top of pay
Well drilled into bottom water at 100 feet below top of pay.
Approximate limit, first edge water as of June 1st 1923
Approximate limit, second edge water as of June 1st 1923
Approximate limit, third edge water as of June 1st 1923

Fig. 3

The assumption of a level water table was responsible for the drilling of so many wells into water. The depth below sea level, at which the water was encountered in drilling, was determined in a very few wells. It was believed that water would be found at this same depth below sea level all over the field. Different operators located water at different subsea depths so there were several water tables extant, while the field was being drilled.

After a great deal of work, with cross-sections, using all the information (in logs and production records) that could be gathered, it was found that the Nacatoch sand contained three edge waters, lying respectively at 20 feet, 42 feet and 72 feet below the top of the Nacatoch pay, and a bottom water at 100 feet below top of pay. A small area at the top of the Norphlet dome had oil in this bottom water sand and it was found to be an edge water sand in the West Smackover field.

A check of the depth of each well, that produced water, against the structure map, showed which one of the several water-bearing strata it was drilled into. The limits of the edge waters were mapped in this way. The water was plugged off in a number of wells by the method that was used in the Mexia field. It might be expected that a line connecting the upper limits of the several edge waters (see L L′ on Figure 2) would be straight and level, in conformity with the theory of the water table. This is not the case.

It will be noted, on Figure 2, that the upper part of the Nacatoch sand zone contained mainly gas on the higher part of the structure. Good completion practice would have been to determine (by coring) at what depth in the sand zone the first good oil saturation was encountered and to case off the overlying gas sand. A core barrel was usually run to locate the top of the sand and the casing was set there. The core barrel was seldom used in drilling in. Many of these wells produced large volumes of gas with comparatively small quantities of oil. Fifteen, twenty, and thirty million cubic feet of gas per day was blown to the air from a number of wells to get 75 to 200 barrels of oil, in the hope that the oil production would increase as the gas volume declined. Tremendous volumes of gas were wasted in this way, causing a shortage of gas for field use within a year. Tubing these large gas wells to bottom and maintaining some back pressure would have conserved much of this gas without retarding the rate of oil production. It was the practice to bail the wells until they began to flow and cleaned themselves. The gas, from the upper part of the sand, entered the well much more rapidly than the oil from the lower sand, where the sand had low permeability. In such wells the hole was cleaned down to the gas sand, but much mud remained in the well below the gas sand. This retarded the flow of oil.

It should be stated, in defense of the operators, that the technique of completing and producing oil wells has largely developed since that time and the function of gas in the production of oil was not generally recognized as it is today, also the modern type of core barrel was just coming into use. It was believed that most of the production would have to be obtained during the short flush period. Large gushers, which were allowed to flow wide open, as was customary everywhere, depleted the pressure in the surrounding area rapidly. Offsets to these usually came in as comparatively small wells. Under the prevailing method of production, haste in drilling wells to completion was necessary.

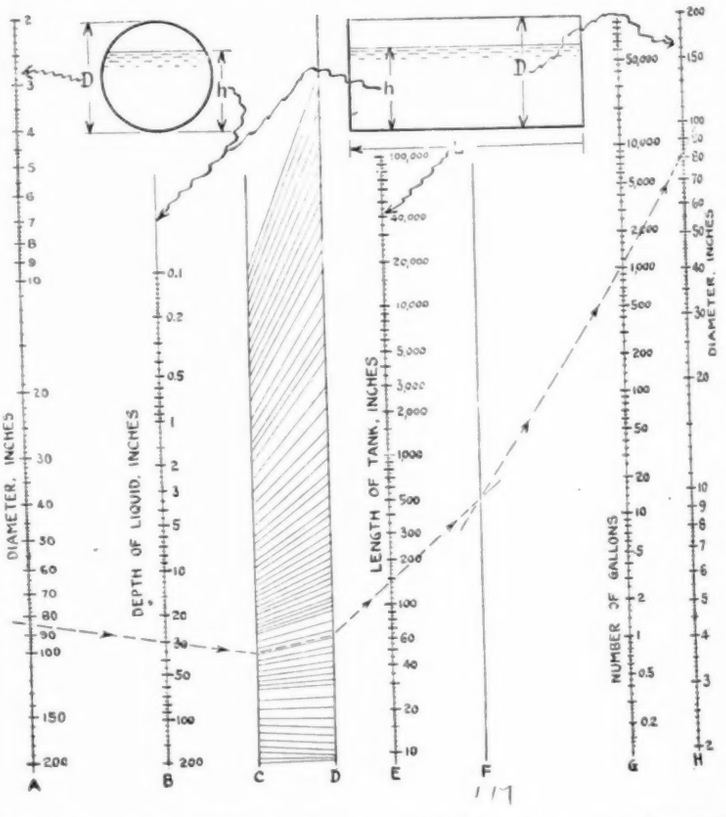
A Useful Horizontal Tank Chart

HERE, at last, is a chart that gives the gallons of liquid in any horizontal tank without the use of tables, formulas, figures, or computations of any kind.

Simply start at the left and zigzag a ruler or thread across the chart three times as demonstrated by the dotted line and the number of gallons is immediately found in Column G. For example: How many gallons in a tank 84 inches in diameter, the depth of liquid being 30 inches, and the length of the tank being 142 inches?

Run a straight line through the 84, Column A, and the 30 in Column B and locate the intersection with Column C. By means of the eye follow the radiating "guide lines" to Column D, locating a second point of intersection. From this latter intersection run through the 142, Column E, and locate the point of intersection in Column F. Then from this point run over to the 84, Column H, and the intersection in Column G will be found to be close to 1,050 gallons, which is the answer.

The range of the chart is amply wide. It will take care of any diameter from 2 inches to 200 inches and of any length of tank from 10 inches to 100,000 inches.



This chart will give an answer much more quickly than tables or formulae. It is surprisingly accurate. It is more complete than tables because it takes care of every dimension between 2 inches to 200 inches, whereas tables generally skip many diameters and lengths giving only 24 inches, 28 inches, 32 inches, 34 inches, etc.

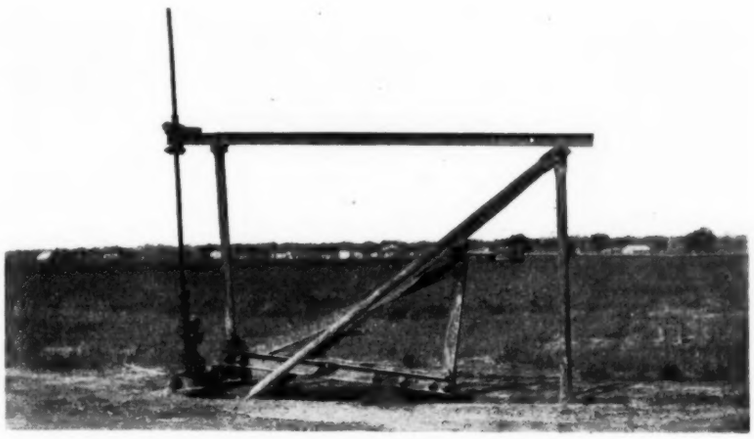
TREATING EMULSIONS *on* LEASES *of* SMALL PRODUCTION

By RICHARD T. BRIGHT*

AN efficient plant for treating emulsions on leases of small production combines principles used in more elaborate installations where large quantities of emulsions are handled daily, with requirements of a small property, which needs a plant of low erection cost and one to operate with a minimum of attention. It is not difficult to construct and much of it can be made from material on the lease. The cost of installing an efficient plant is not much greater than an inefficient plant and is soon paid for by an increase in the gravity of the oil, a reduction in loss of volume due to evaporation, and a reduced chemical cost.

In some cases the emulsion may be broken down by the use of heat alone, but in the plant described in this article, provision is made for the introduction of the chemical to be used with the more obstinate emulsions.

Introducing the chemical down the well is successful in some pumping wells, but is not the most economical method, except where only one or two wells are cutting. Some wells cut only in cold weather and form an emulsion that is easily broken down. These wells may usually be successfully treated down the hole, in which method the chemical mixes with the emulsion and is aided by the natural heat of the oil. Often this oil can be run directly to the wash tank without the use of a heater. Treating down the hole will sometimes keep down paraffin troubles on wells with that tendency.



One of the many smaller pumpers in northeastern Oklahoma.

In the majority of cases it is better to treat at the surface. If soft water is added to the chemical before it is mixed with the emulsion it will treat the emulsion more effectively and use less chemical. The chemical acts as a water softener and if it is mixed with hard water, the strength of the chemical is reduced in softening the water.

The accompaning sketch presents a treating plant which has a maximum capacity of 80 to 100 barrels per day. The design and operation is similar to larger plants, but certain features have been omitted or changed to fit the smaller production. In this case the settling tank has been eliminated; the sizes of the tank and heater reduced; and a gas trap to be used in conjunction with the conductor is added.

Chemicals should be introduced into the emulsion by a force feed pump or a lubricator, situated as far away from the wash tank as practicable, to give time for thorough mixing in the lead line. The lead lines from the wells should be brought together in a header or manifold, located a considerable distance from the wash tank. Where the emulsions are uniform it is better to introduce the chemical directly into the header. If one well is making the most stubborn emulsion, it is frequently feasible to introduce the chemical for all the wells into the lead line near the casing-head of this one well. This method provides chemical for the stubborn emulsion with sufficient excess to care for the emulsion from the other wells when they come together in the header.

After the chemical has been introduced, the emulsion and the chemical are mixed by agitation in the lead line and pass to the combination conductor pipe and gas trap. In this case it is assumed that the gas supply is small and the conductor is extended above the top of the tank to act as a gas trap to supply gas to the heater and other lease purposes. If the gas supply is large in proportion to the production, the size and height of the conductor can be increased accordingly. If the conductor is too small the gas will spray oil into the gas line and the installation of a drip will be required. Prior to a few years ago conductors were generally placed inside the tank, either in the center or a few feet from the side of the tank opposite the oil outlet. A hood or spreader was placed above the oil outlets in the base of the conductor to insure better washing. The outside conductor shown is just as satisfactory and has the advantage of cheaper installation cost. Experience has indicated that the oil emulsion should pass into the wash tank about 18 inches from the bottom. Section A-A through the tank shows the connections used. One side of the cross-tee is bull plugged.

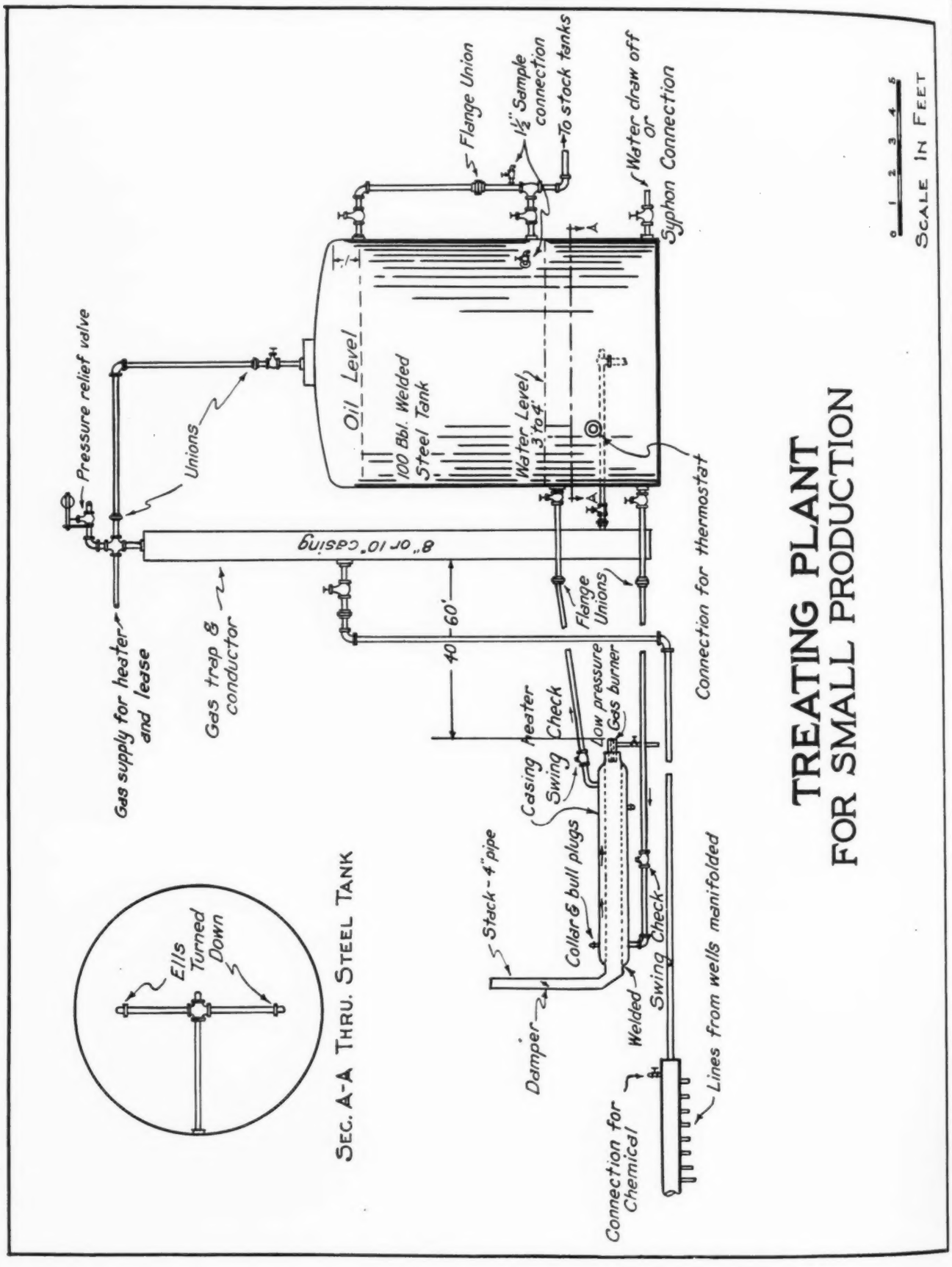
The water heater is made from a joint of old casing. Welding costs vary greatly, but a fair estimate would be $35 for making the heater. The water in the tank is kept warm by continuous circulation through the heater. The temperature of the water depends on the kind of emulsion being treated, but should be maintained as low as possible. A temperature of 120 degrees is usually required. The water level in the tank should not be less than three or four feet. In many instances a better wash and a longer settling out time can be maintained by increasing the amount of water in the tank to about one-half the height of the tank. The water level can automatically be kept at any desired height by the use of a syphon.

A welded tank will prevent excessive loss in gravity due to evaporation. It should be sufficiently large to insure plenty of time for the water to settle out. If the tank is

*Petroleum Engineer, Tulsa.

too small, the emulsion does not have sufficient time to break up, and cut oil will be carried into the stock tank. A small tank will require the use of more chemical because of shorter settling time. The extra cost for a larger tank will soon be repaid by a saving in chemical. As the emulsion hits the warm water in the tank, it is gradually broken down. The water settles to the bottom and the clean oil rises to the top, where it goes over to the stock tanks.

There are many variations of the above described plant, many of which are its equal in efficiency. This, however, will serve as a general type of an efficient plant for treating small production.



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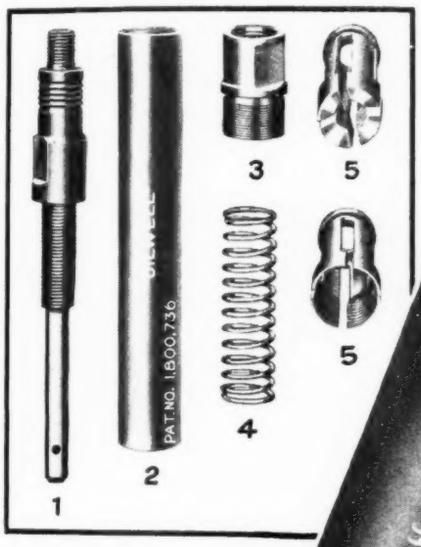

1. Releasing Top.
2. Bowl.
3. Bowl Top.
4. Spring.
5. Slip Cage.
6. Threaded Shoulder Pin (not shown).

You need not strip the tubing, break the hold, back off or unscrew. Five or six turns to the right effect instant release of this Socket, on the derrick floor or in the hole. Just use a wrench on the releasing top, or on the rods above it. Another exclusive feature is the one-piece slip cage, with positive grip. Two sizes of cages furnished with each 2″, 2½″, or 3″ Socket. Heat-treated, hardened, alloy-steel cages and bowls. Request Folder 430.

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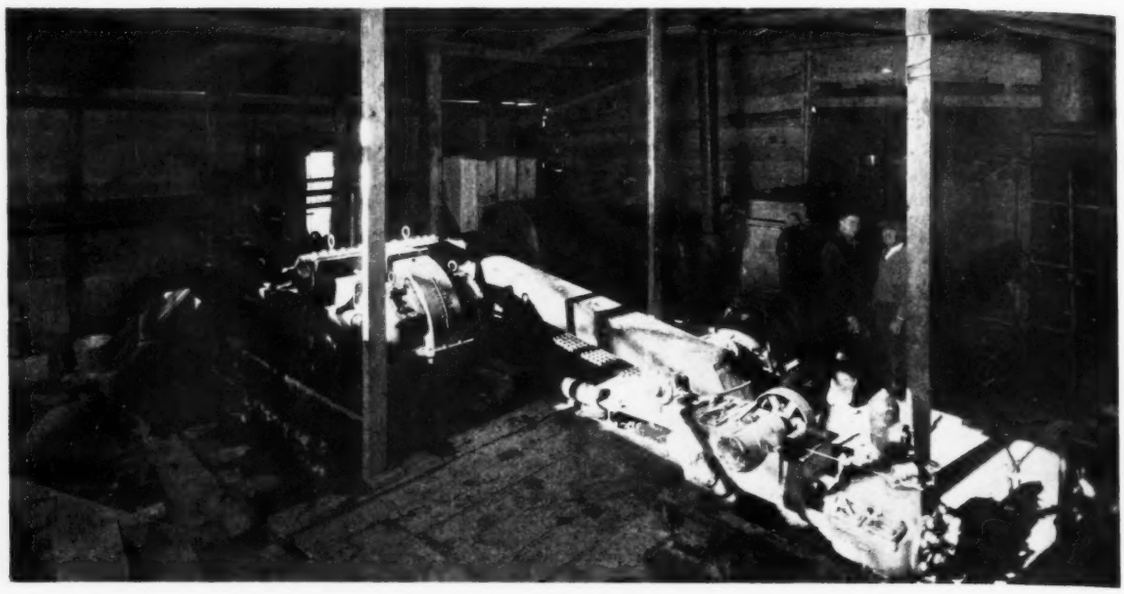


Here is shown the Diesel engine hook-up to slush pumps.

Diesel Rotary Rig Drilling

By D. S. DEEM*

THE subject has long been discussed, and even debated, as to the possibility of operating the larger rotary drilling rigs with Diesel engines through a mechanical drive. That, however, is no longer a matter of speculation; it has been accomplished.

Producers in testing wildcat acreage, especially where suitable fuel and water are scarce, such as in Western Kansas, have found that any prospect of reducing these items of power cost must be given careful consideration. The more progressive contractors have sought ways and means of effecting economies in the drilling operation by trying larger and improved steam rigs.

It is now generally recognized that the Diesel cycle of combustion is an exceptionally efficient method for converting certain cheap fuels into mechanical energy, in consequence of which alluring pictures have sometimes been painted of the wide field awaiting Diesel engine application in drilling. A serious study of the subject reveals many of the complications involved. First, a mechanical drive is to be desired, as it will reduce the first cost and simplify operation. Second, the engines must be light enough in weight to permit easy truck transportation without being dismantled. These two limitations are not easy of solution, for it should be remembered that in Kansas and Oklahoma heavy drilling rigs are used, the formations are hard, and time is the essence of all contracts.

It must be apparent that to accomplish all this two or more engines are required, although countless drive arrangements have been considered to permit a transmission of the power output of any engine to either the drawworks or slush pumps. An elaborate drive, however, is not very practical. Careful reasoning and experience indicate the necessity of using one engine for the drawworks and another for the slush pumps.

In the very beginning it is necessary to rule out the conventional slow-speed, heavy power plant Diesel. Also, for a mere want of power it is also impossible to use most of the so-called mobile Diesels. Engine selection is further narrowed by the requirements of drawworks operation, for which rapid and wide speed range is needed in pulling drill pipe. Observation indicates the desirability of increasing the engine's slow or idle speed as much as three to four times, and that almost instantly if performance similar to that obtained with steam is to be approached.

In the spring of 1930 the Herndon Drilling Co. took a novel step in Diesel drilling. Arrangements were made for the delivery of two Diesel prime movers and other special equipment. Late in November, 1930, this equipment was installed at a well of the Gypsy Oil Co. in Ness County, Kansas, and consisted of:

Two Type L 8-cylinder Diesels, together with complete accessories, radiators, and air starting unit.

Two 7¾-inch by 18-inch 15,000 duplex power slush pumps with two-speed gear box.

One reverse clutch.

Two roller chain drives from Diesel motors to reverse clutch and to pump gear box.

Other equipment at the well included:

One three-speed drawworks, together with crown and traveling blocks, line, 6-inch drill pipe, etc.

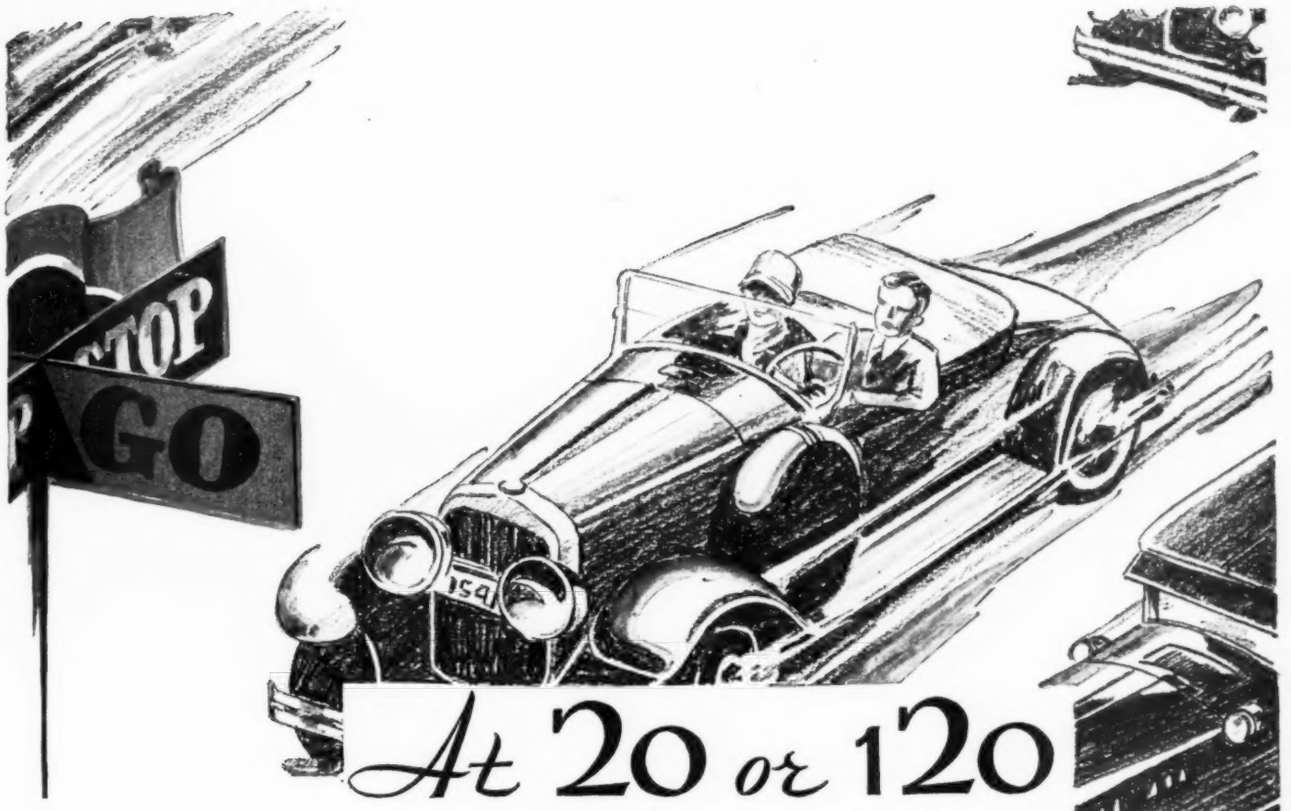
One lighting unit.

One rotary drive chain—reverse clutch to line shaft.

Seven 16-inch by 16-inch timbers for drawworks engine foundation.

Two-inch by 12-inch planks laid edge to edge on the leveled ground and crossed with 2-inch by 12-inch

*Fulton Iron Works Co., Debt is acknowledged and thanks extended for information and co-operation during this test run to Ted Rakestraw, Herndon Drilling Co., their drilling crew and the Lucey Products Corp.



At 20 or 120

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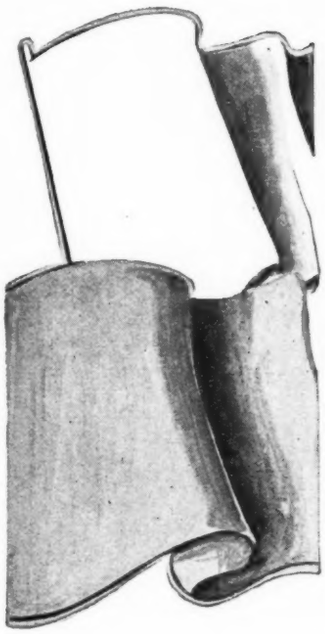

Barnsdall engineers working with a background that reaches back to the very founding of the Industry itself have produced such an oil – BE SQUARE *Stabilized* Motor Oil the lubricant that ignores the thermometer giving you perfect protection always. Also distributors of MONOMOTOR OILS, a complete line tested for perfect performance over a period of years.

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planks forming a mat were used under the pumps and their driving engine.

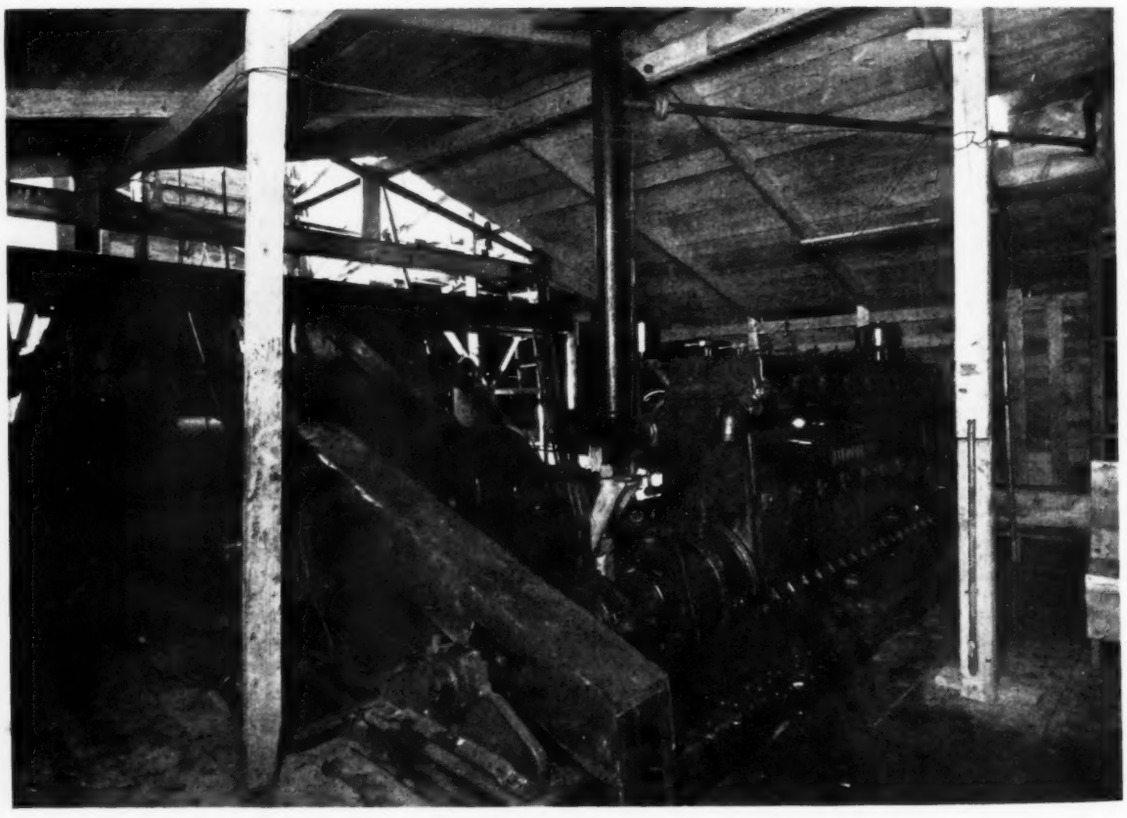
A conventional rig set-up was followed in so far as possible with the drawworks and Diesel motor on the side of the derrick. Three 16-inch by 16-inch mud sills were laid down and to them were keyed four 16-inch by 16-inch pony sills, the engine and reverse clutch being placed directly on them with ties and braces to make secure the reverse clutch. The engine was not fastened in any way except for a spacer pipe between engine and clutch to overcome the side pull of the quadruple roller chain used for the power transmission from engine to reverse clutch. Even with this simple and inexpensive foundation no trouble was encountered from vibration or machinery movement.

A telescopic type steam throttle was adopted to control the reverse clutch employing three positions for complete control; i. e., hand wheel against jack post to give forward, half extended for neutral, and reverse when fully extended. Rotation of the hand wheel to the right decreases engine speed and vice versa, a procedure quickly mastered by the drillers.

As mentioned in the material list, 2-inch by 12-inch timbers were matted to serve as a foundation under the slush pumps and their driving engine, situated on the right-hand side of the derrick. This was satisfactory until wash water from the piston rods soaked the ground, causing it to become soft. In the future it is the intention to use a set of large cross timbers under the pump unit. By the manipulation of a coupling either pump could be quickly cut-in to service. At normal engine speed with the large pinion engaged in the gear box, the pumps operated at fifty strokes but it was only a moment's operation to shift gear box pinions and reduce the pump strokes to 40, this being useful in jetting the cellar, mixing mud and pumping down the plug.

Thirty-eight hundred and sixty feet of 8¼-inch casing was set in 709 operating hours, during which 300 barrels of crude oil for engine fuel and 50 barrels of water for the engine jackets were consumed.

It was discovered that the rig could be speeded up somewhat by a more suitable selection of sprocket ratios and this will probably be done on the next location; however, observation while pulling six-inch drill pipe from 3500 feet depths or greater, and without the knowledge of the crew, in other words, routine operation, showed that it required from one minute and seven seconds to one minute and 18 seconds to set back a thrible (approximately 100 feet). When coming out of the hole at 3000 feet or greater depths, it was easily possible after setting back two or three thribles in low to change to second speed and set back ten or 12 stands and then go into high speed.



Here are shown the draw works and the Diesel engine drive through reverse clutch.

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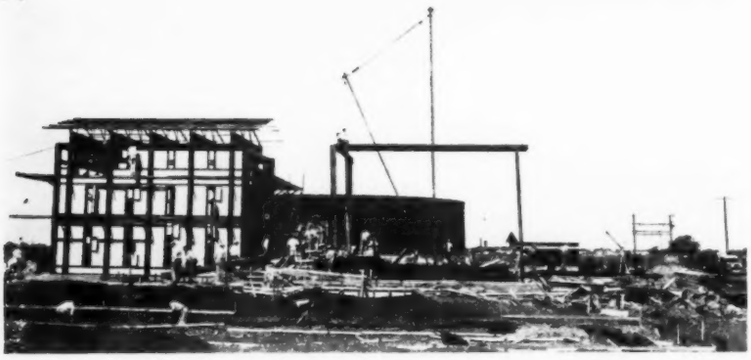
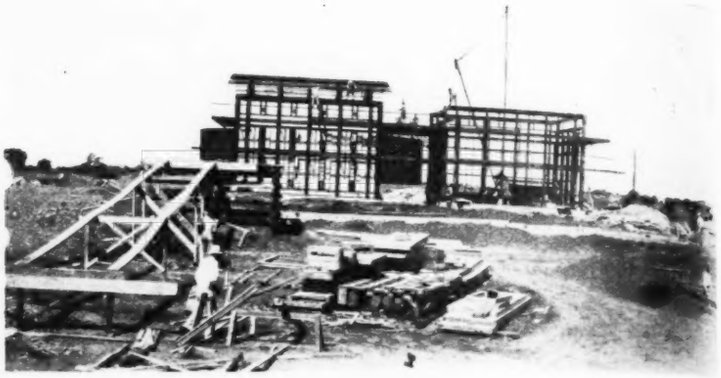


Left — Installation of transite sheathing on high-pressure furnace and erection of structural steel for low-pressure furnace.

Below—Building of platform and runs for pouring concrete to control house, cooler box, condenser box foundations.

Modern Refinery Construction



By H. LITWIN[1]

OUR present stage of development in the technique of refinery construction has resulted from costly experience obtained through trial and error. Previously, due to the very rapid increase in the demand for oil products and the profits garnered by even the least economical refiner, little consideration could be expected for a thorough study of the best means of refining. It was sufficient that a process was operable, whether well or ill.

Of late years, it is becoming increasingly evident that operating cost is a major factor in determining the economic condition of a refinery. Also, the consumer is becoming educated to look for certain qualities in the gasoline and lubricating oil he buys. Thus, the refiner, when installing new equipment, very naturally looks for something which will give him high quality products for the lowest actual cost. However, he must still consider that low first cost is not always a guarantee of low processing costs. With the present stage of advance in engineering and the established state of the industry, equipment will not tend so readily as before toward early obsolescence, so that it is wisest now to place capital in equipment which will stand up for a long period of years.

The place of the construction engineer is to satisfy this demand of the refiner for efficient equipment, which service he can render due to a specialized experience and his susceptibility to the infiltration of new ideas from this and allied industries. In order to give to the refiner a satisfactory unit at low cost, he must provide for the harmonious co-operation of the various elements entering into a complete project.

First in the program of building a new refinery unit comes engineering design. Since this article deals primarily with actual construction, the part played by the designer will not be elaborated upon, other than to note that the work of this department is to decide first upon the best fundamental processes and then to work out in detail the requirements for each particular job. He must keep in mind always the objective of simplicity in the individual parts and in the whole. Where possible, he should use more or less standard parts, which entail no special difficulties of manufacture in the shop or construction and erection in the field, thus lowering appreciably construction time and cost.

The charge of the chief engineer is to produce the working drawings of the various pieces of equipment in the order which will allow the equipment to be manufactured and delivered when needed in the field, and to keep the field construction superintendent supplied in advance with all the necessary construction and erection drawings. This engineer must so plan the work in his department that there will be no hitch in the steady progress of construction.

The purchasing department, in addition to the ordinary purchasing work, must see to it that the equipment is equal to specifications and that it is delivered at the time required.

The chief construction engineer, who is stationed in the office for the most part, must keep in constant touch with all progress in both the office and field and assists the field superintendent if any difficulty is encountered. The field superintendent keeps the office constantly informed as to the progress of construction by means of daily progress reports. These reports give an itemized account of the work done during the day, the progress up to the end of that day in percentage of the total work, the material received on that day, the material to be required within two weeks, and the drawings received. An itemized list of the various kinds of workers employed is also given. With this information at hand, the office is enabled to control the field work and furnish the material as needed, so that there is no break in construction with resulting loss of time and money.

The construction superintendent bears a large responsibility in determining the final quality and cost of the construction. By having plenty of material at hand, and with work outlined ahead, he can keep the men working at top speed throughout most of the construction. The speed will unavoidably fall off toward the end as the work in sight

[1] Winkler-Koch Engineering Co.

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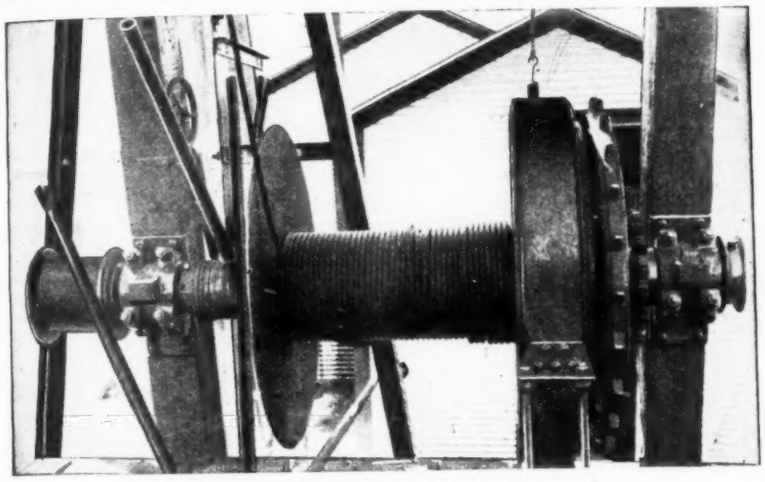

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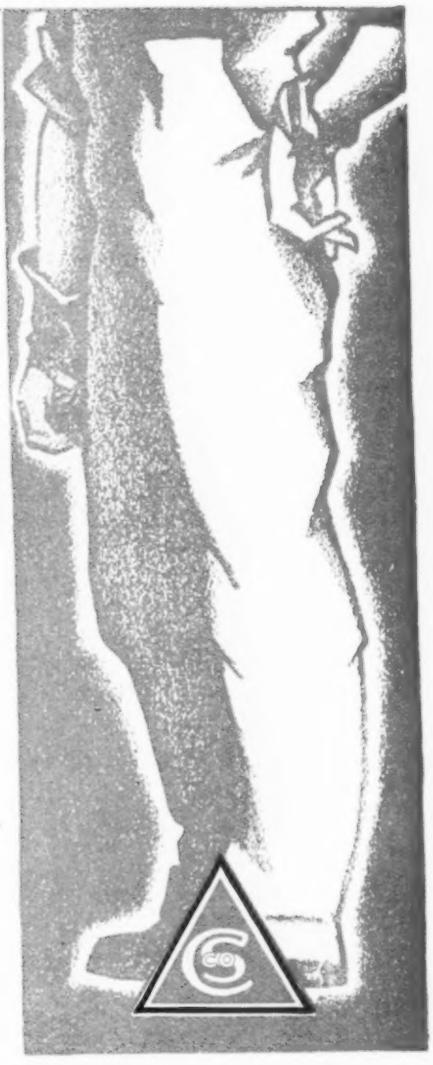

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decreases, so that the force must be pruned constantly instead of allowing men to hang on unnecessarily. The field costs can be kept down to a minimum by a judicious handling of the men and materials. Finally, the superintendent has it in his power to make either a sloppy, careless job, or one neat and pleasing to the eye. He must see that the piping is straight, the exposed concrete finished smoothly and the brick laid evenly—in short, he must give his attention to numerous small details which may be otherwise overlooked in either the office or field.

Before any actual work can be done on a certain project, a suitable plot of ground must be chosen which will fit in with any present equipment, and which will provide sufficient space for future expansion and development. In determining the plant layout, consideration must be given to the arrangement of equipment so that each part is easily accessible for attention or repairs, and that the piping is as simple as possible, withal maintaining a satisfactory compactness of the whole.

The attention to or neglect of a number of considerations will differentiate between good and indifferent engineering and construction. Among these, one of the most important is piping.

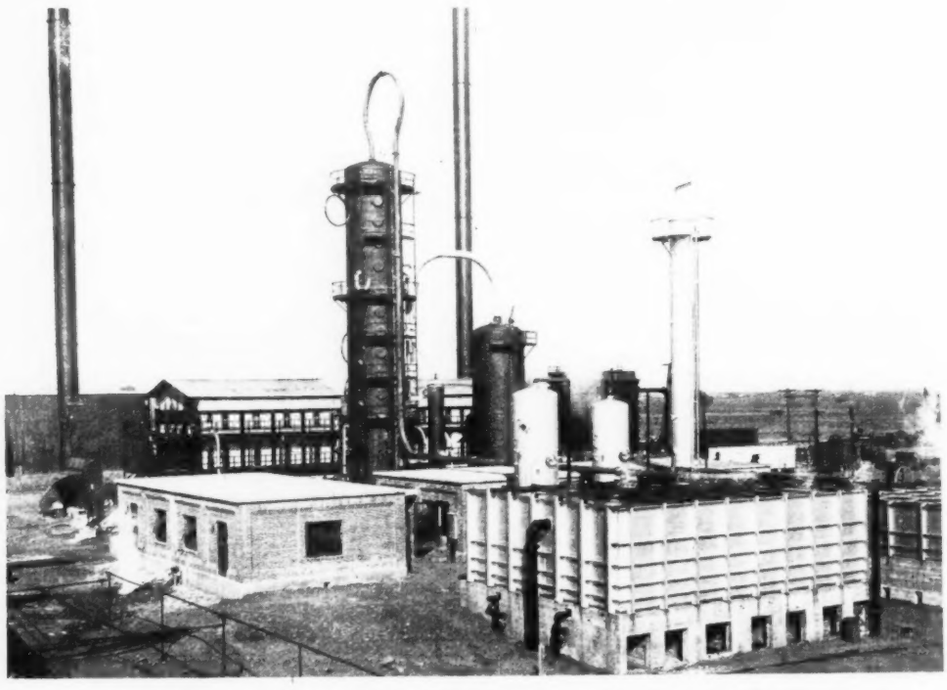
Simplicity and neatness in the piping layout will add immeasurably to the appearance of the unit. Also, there must be due regard given to the size and strength of the various lines and fittings corresponding to the conditions to which they are to be subjected. Ample provision must be made for the expansion of hot lines to prevent connections from being loosened. Overhead piping must be supported firmly to prevent vibration.

Providing over-size pumps so that they may be run slowly will lessen shocks and vibration, both in the pumps and in the whole system, and lengthen the life of the unit. An economical measure is the furnishing of a standby pump for each service, except where the pump is unusually expensive. Mechanical lubricators and steam governors are necessary adjuncts to the equipment.

Ease and simplicity of operation and control must be considered. Where constant operating conditions are necessary, automatic indicating and recording control instruments are highly desirable. The use of automatic controls reduces the work of the operator and allows him to devote his attention to catching any irregularity which might result in shutting down the unit. Indicating instruments are provided for the less important temperatures and pressures. All instruments are brought to a central board in the control house, where the whole picture of the operation is presented. With suitable regard for these considerations of simplicity and ease of control, and avoidance of extreme conditions of pressure and temperature, long continuous periods of operation may be expected from year to year. It is of interest to note that one refiner processing Seminole and Oklahoma City reduced crude in a high pressure unit has obtained continuous runs of over one hundred days, including a run of one hundred twenty days when running to a 13.5 degrees A. P. I. Bunker "C" residuum. The operation of this plant has been marked by freedom from any difficulties—not even a tube in the furnace has been replaced after two years' steady operation.

A consideration for the safety and comfort of the operator means dollars and cents to the refiner, without regard for even the humanitarian aspect, since the actual results obtained from any refinery unit depend considerably on the work of the operator. All pieces of equipment should be readily accessible for attention and repairs. The pump and control house, which contains pumps and the major manual and automatic controls and valves, should be fireproof, clean, roomy, well ventilated and well lighted, with a nicely finished interior. Oil sampling lines should be provided from each pump. Vapor-proof fixtures and switches must be used. Where motor-driven pumps are used the motors should be separated by a wall from the rest of the equipment. The yard lighting must be sufficient to give correct illumination. The use of flood lighting has been successful, giving ample illumination without glare to all portions of the unit.

The accompanying photographs show the progress during construction of a combined high pressure and low pressure unit for a large Texas refiner, the unit being completed in 129 calendar days after the signing of the contract, or 109 days after the start of construction.



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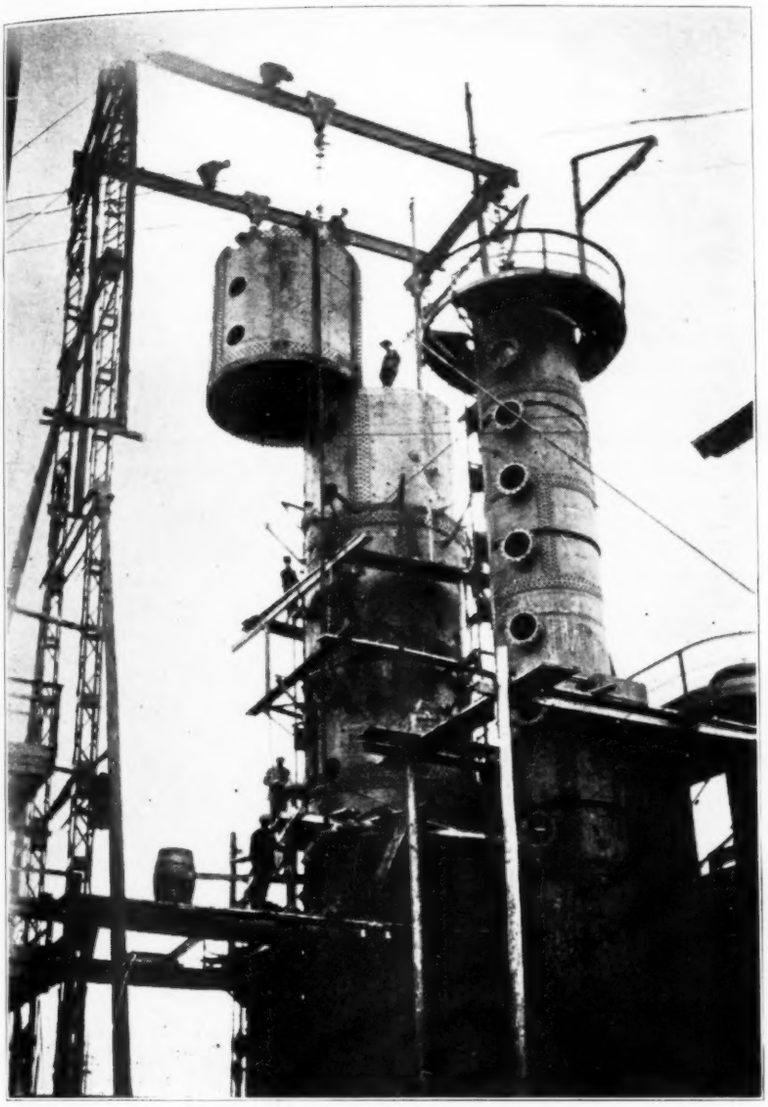

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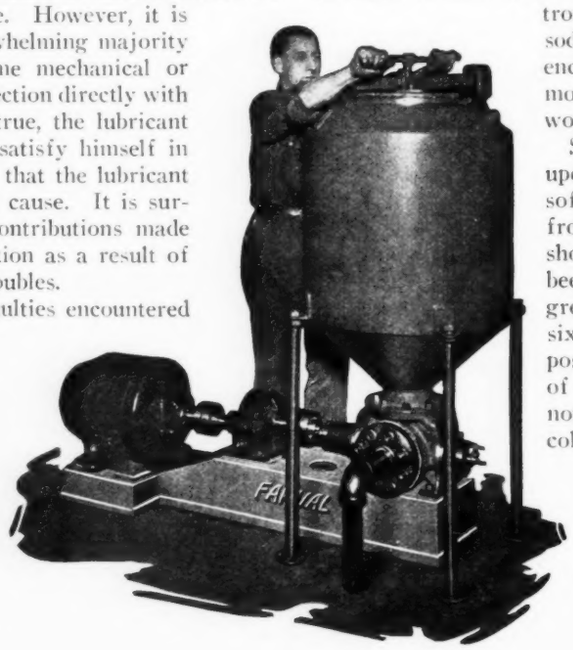
Troubles and Remedies in

Grease Lubrication

By **H. R. MATHIAS, Lubrication Engineer**

SO far in this series consideration has been given to estimation of service requirements so that the proper grease or oil may be applied. In addition, the methods of application have been studied so that the grease may give its utmost in use. The job is not finished. We must turn our attention to the performance of the product, consider actual results that are obtained, and, if trouble develops, seek the causes so that remedies may be applied.

Trouble to most everyone is something to be avoided, and lubrication troubles, especially. Vexatious delays owing to lubrication faults interfere with production schedules, result in loss to company and workman, and sometimes are very difficult to eliminate. It is this fact which is probably responsible for the phrase, "Blame the oil." It is but natural that the thing about which least is known should be considered responsible for trouble. However, it is a matter of record that the overwhelming majority of troubles are traceable to some mechanical or other difficulty and have no connection directly with the lubricant. Sometimes, it is true, the lubricant is at fault. The engineer must satisfy himself in this connection and, if convinced that the lubricant is all right, search for the actual cause. It is surprising to know of the many contributions made to the science and art of lubrication as a result of field investigations of service troubles.



One of the most common difficulties encountered with greases is separation of the soap and oil. It often occurs that some one bearing of a group of similar bearings runs hotter than the other for no apparent reason. This particular bearing may easily be overlooked during an inspection, only to cause difficulty later on. A cup grease may have been chosen on the basis of the requirements of the group. If the bearing in question is running at a temperature over 175 degrees F., separation of soap may result, grooves may become clogged, lubrication may cease, and another job of rebabbitting is necessary. Only too often is a change made to a grease for that one bearing which will not separate under elevated temperatures, making necessary the carrying of a special product for this one isolated case. A more satisfactory solution and one productive of the most good in the end is to find out why that bearing runs hotter than its fellows. Perhaps the cause is misalignment, perhaps someone forgot to groove the bushing, perhaps the bearing is not getting enough grease for its requirements, perhaps the shaft is rubbing against something, producing a local overheated area whose heat is transferred to the bearing. The bearing may have been adjusted too tightly so that it binds, or too loosely so that pounding is destroying the bearing surface. These are but some of the things which may cause a bearing to run hot and result in inability of the particular grease chosen to function properly.

Cup greases and most other calcium greases separate if used at or near the boiling point of water. The reason for this is fundamental. Such products are mixtures of soap, oil and a little water, as previously pointed out. The water is extremely important to the structure of the substance. If, then, temperatures are high enough to evaporate the water, the balance is disturbed and the soap and oil are no longer held in combination, but separate.

Many bearings run hot because of proximity to a heated body, such as a heat-treating furnace, a ladle full of molten metal, a cement kiln, or a steam-heated dryer roll. Although at times temperatures may be moderate, the lubricant chosen must be effective throughout the possible temperature range. In cases of this sort calcium greases are likely to give trouble and should not be used. A sodium grease of the proper consistency is usually chosen, even though most of the time a calcium soap grease would be satisfactory.

Separation may occur in cup greases upon long standing, especially the softer grades. In distributing stock from oilhouses, the oldest grease should be moved first. Cases have been known where a barrel of cup grease has been held in stock five or six years, when it would have been possible to move it within a few days of receipt. Sometimes the grease is not harmed except for a darkening in color. Usually free oil will be found floating in puddles on the grease or soaked into the package, as the case may be. Best results are obtained if stock sufficient only for a short period is kept on hand. Greases should not be allowed to stand unused more than six months under ordinary plant storage conditions. If, owing to unavoidable circumstances, such as long shutdowns, a longer time should elapse, examination of the package should be made to determine whether or not the grease is fit for the service intended.

Separation may occur in a pressure feed system. Not long ago a complaint was received that feed lines were clogged in a pressure system on a large bridge crane used on open hearth service. Assurance was given at the time of application of the soft cup grease that temperatures would never exceed 140 degrees F. Investigation developed that at times when exposed to the heat of a ladle full of hot metal, temperatures rose as high as 230 degrees F. on some of the distributing pipes. The difficulty was solved by changing to a sodium soap grease, since the craneman, being a cold-blooded creature, could not be influenced to stay away from hot metal any longer than possible.

A common trouble experienced with cake greases used

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on high-temperature service is glazing and carbonizing. Glazing is probably due to partial oxidation and drying out of the surface of a cake preceding actual carbonization. If temperatures are high and the grease too hard to feed sufficiently fast, the changes mentioned take place in the surface film of the grease in contact with or near the journal, making a hard, varnish-like film. This film effectively seals any further feeding of grease. In time, carbonization sets in and bearing temperatures mount to the destruction point. If not caught in time, the bearing may become smeared or scored. The obvious remedy is the use of a softer product which will feed fast enough to eliminate formation of this glazed film. Often greases of too high melting point and of too hard body are recommended for such service in the effort to secure minimum consumption. A sensible balance must be maintained between consumption and lubrication if such trouble is to be avoided.

Let us now consider gear lubrication. In recent years much attention has been given this subject. Fully enclosed reduction gear sets, pinions and gear trains have been introduced equipped for heavy oil lubrication by bath or full pressure circulation. The use of gear shields has been rendered unnecessary in these cases. Gear shields, because of their asphaltic nature, are subject to changes in use peculiar to asphalts alone. There is no question but that gear shields have their place and usefulness, however. If the proper bodied oil can be delivered to the gears, preferably under pressure to the mesh point, with suitable provision such as a filter or centrifuge for removing water and dirt, oil is to be preferred to gear shield on account of its ability to remove heat and lubricate with minimum loss of power. In this article, of course, we are especially concerned with grease lubrication and for that reason must leave the discussion of the relative merits of oil and grease for gear lubrication to a later date.

Numerable cases have arisen of trouble with gear sets where oil is used on the bearings and gear shield on the gears. Gear shield in time leaks into the oil system and oil into the gear shield. The result in the first case is hot running bearings and gummed-up circulating system and filter; in the second case, the body of the gear shield is often greatly reduced and undue gear wear results. These troubles can be eliminated by lubricating both gears and bearings with the same oil by use of a pressure circulating system. In cases where this change cannot be made for various reasons, installation of oil thrower collars on the shaft and regular replacement of seals has helped considerably.

Another common complaint resulting from the use of gear shield in enclosed gear cases is overheating of the gears and bearings. This may be caused by the use of a gear shield too heavy in body. Experience has shown that the heavier the gear shield used, the more power is consumed in overcoming the resistance of the lubricant. This lost power appears as heat, which is transferred through the body of the gears to the bearings. A case recently investigated is of interest in this connection.

A certain pinion stand was giving trouble from overheating and failure of the neck bearings. Investigation disclosed that the trouble was not in the neck bearings or with the neck lubricant, but was due to the heat conducted from the body of the pinions. Temperature of the air in the enclosed housing was 332 degrees F., this high temperature being caused by power loss in overcoming friction of the very heavy gear shield in use. Immediate change to a very much lighter gear shield dropped the running temperature at once to slightly above room temperature, a reduction of over 200 degrees F. Needless to say, no further bearing trouble has been experienced.

Oxidation, to be sure, takes place with other lubricants, producing changes in color, acidity, resistance to emulsification, etc., but no increase in hardness or melting point and relatively little change in viscosity in the case of oils. No way is known of preventing this change in gear shield. Therefore, in use, gear shields gradually become heavier, power required to move the gears through the lubricant becomes greater, frictional loss increases and the gears overheat, until the product gets so heavy that it must be removed and be replaced by fresh material.

In one case recently examined the gear shield in use had increased in a four-month period from 40 degrees F. to 270 degrees F. in melting point and when cool was as hard as an asphalt street in winter. Nothing could be done about it except to scrape out the hard material and fill the housing with fresh light lubricant. Owing to operating conditions at this particular place, this will have to be done at least every six months, unless some other system of lubrication not using gear shield is employed.

So far we have discussed some of the troubles encountered with gear shield lubrication of enclosed gears. Open gears, too, present many problems. Some open gears run very hot, owing to location near a heated body; some run in a very dusty atmosphere, others under water; some run at high speeds and some very slowly; some are exposed to the blistering heat of white hot metal one minute and below-zero weather the next. These varying operating conditions, representing the more common, affect the choice of lubricant profoundly and the results to be secured.

The most important requirement of a gear shield to be used on open gears is that it must be adhesive under the operating conditions. Open gears are usually "doped" infrequently; hence the application must last until the next time around, which in some cases may be in an hour, in others a day, and in one recent case, a month. Gear shields are usually applied to open gears in a melted condition by means of brushing, pouring or spraying. They must therefore be fluid enough at the application temperature to permit ease of handling. It is a demonstrable fact that gear shields which are easy to apply will be put on more often and more thoroughly over the gear, resulting in better lubrication.

Open gears operating in very dusty surroundings should be lubricated often with the lightest possible gear shield that will give results rather than infrequently with a very heavy product. If this is not done, the abrasive dust will be caught and held to the gear teeth for a long time, resulting in great wear. Mixtures of gear shield and cement dust, for example, are very effective in producing a high rate of wear. Gears which must operate under such unfavorable conditions should be protected as much as possible by covers from the ever-present dust. In some very aggravated cases no lubricant at all should be applied.

Open gears subjected to extremes of temperature are often better taken care of by gear grease than by gear shields. Gear shields are, after all, but very viscous oils, becoming thin with heat and heavy when cold. Gear greases are not subject to such wide consistency variations. They do not run off under moderately high temperatures, nor become brittle and chip off at low temperatures. Gear greases are also of specific value for lubricating those gears operating under water.

With this concluding article of the series, it is the author's sincere hope that the highly involved, often very technical matters concerning grease lubrication have been made a little plainer and that those concerned in the use of greases will feel that benefit has been derived.

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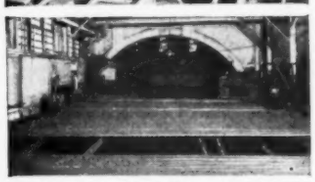

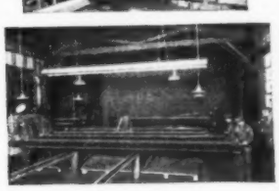

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The Use of . . . . ARTIFICIAL COLOR *and* ODOR *in* . . REFINING

By
Dr. WM. T. SIEBER
Chief Chemist
Waverly Oil Works
Pittsburgh, Pa.

Vapor recovery plant, Sweetwater, Texas.

COLOR and odor have always played an important part in the marketing of a variety of finished products and therefore one must not be surprised to find that they also affect, to a great extent, the marketability of petroleum lubricants. The influence of color and odor, however, is not quite as pronounced in the oil industry as it is in some other lines, for instance in the manufacture of cosmetics, but still should not be overlooked.

To a certain extent, the color of lubricants has been adopted by the buying public as something natural, or as something which needs no special mention. For instance, motor oils should have colors to correspond to their respective viscosities; kerosene and naphthas should be colorless; neutral oils for blending should have a color not darker than No. 3 NPA, and cylinder stocks should be a distinct green and not brown. The odor should be naturally sweet and not offensive. These specifications are based on properties of highest refinement and give the customer the assurance of buying quality products.

But times have changed and the oil industry has become affected with the same trouble which heretofore had been prevalent in so many related industries, that is, the desire to make its finished products more pleasing to the eye and decidedly more aromatic. The industry then adopted the use of artificial colors and odors in order to effect the desired characteristics in its finished products. From the practical standpoint they do not detract in any way from the quality or efficiency of the lubricants, as they represent more or less added properties, which the manufacturer gives his products in order to make them more desirable to the public.

Years ago it was quite a fad to use red kerosene in oil lamps, as it was evidently more pleasing to see a colored illuminating oil contained in the oil reservoir rather than a white one. Therefore the refiner had to color his kerosene with alkanet root in order to satisfy the consumer. It meant additional expense, but the public was willing to stand it as long as the finished product met their approval.

Lately quite a different trend with regard to color and odor has become noticeable in the oil industry. Take for instance, the present-day motor fuel. The public can buy gasoline of most any color, from yellow to purple, practically every color of the rainbow, and the feminine motorist of today is able to buy a gasoline to match in color the shade of her gown or the color of her automobile. The question turns up—does the color make the gasoline any better? No. It is more or less a matter of style—a desire of giving your product a distinct, easily recognizable characteristic in order to make it stand apart from competitive products. On the other hand, colored gasoline acts as a kind of protection for the buying public, as it more or less assures the consumer of getting what he asks for.

The refiner and the marketer have found it already advisable, in certain specialties, to disguise the natural odor of the petroleum products by the addition of synthetic perfumes, as in the case of cleaning and cigar-lighting fluids. But all these additions are only means to facilitate the marketability of the products and are subject to the individuality of the manufacturer. They do not improve the original quality—and they make it more complicated for the refiner. Special oils, like valve oils, carbon remover, etc., are mostly colored in very attractive shades in order to make them appear more efficient in the eyes of the public. They are also given characteristic odors, by addition of oils, such as citronella, wintergreen, sassafras or pine.

With respect to coloring and perfuming lubricants it is the writer's opinion that there is always a grave danger in overdoing it. There is also the danger of the educated public mistaking the color and odor as "covering up medicines" for cheap and ill-smelling raw materials. In some instances this is true, as there are some unscrupulous manufacturers who are using inferior raw materials and by giving the finished product an attractive color and a loud odor make it look and smell like a quality product.

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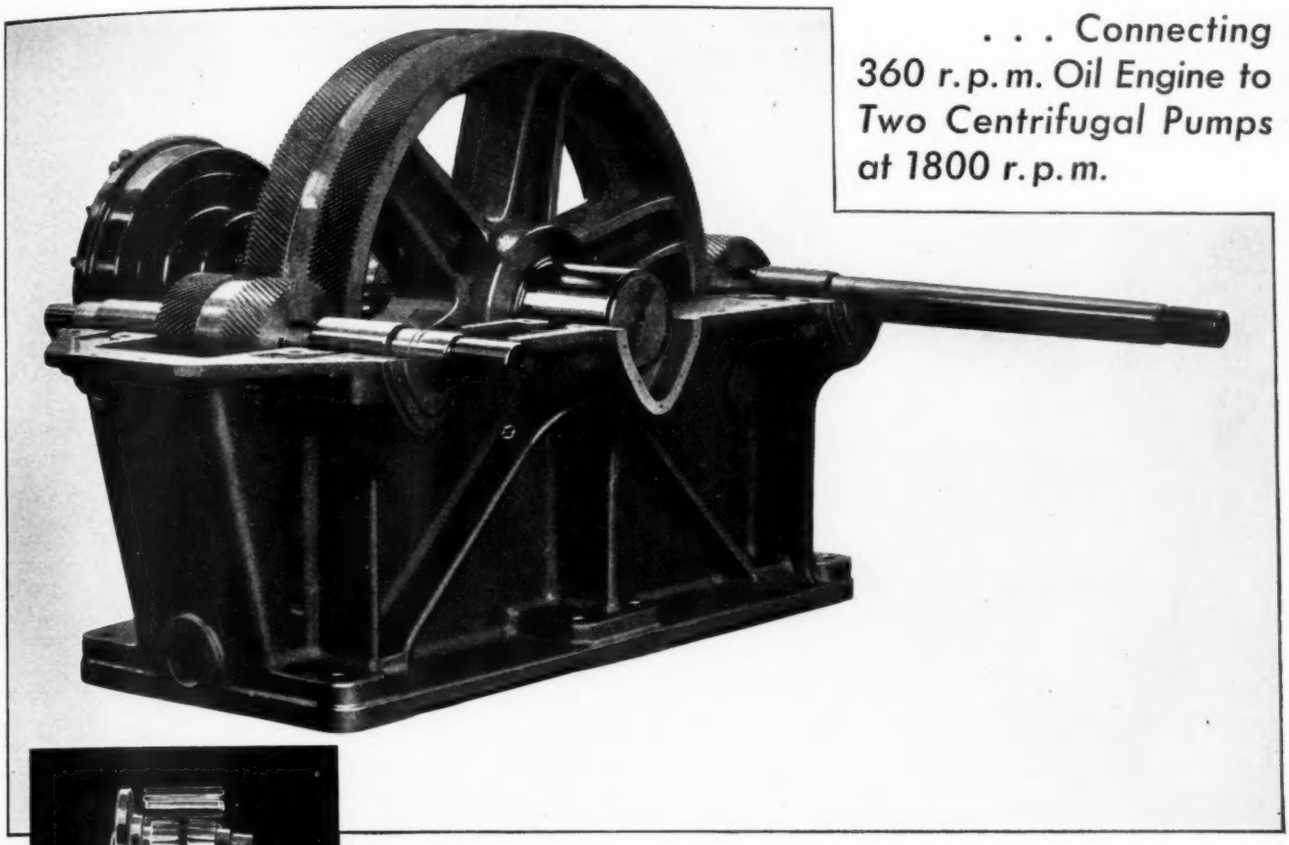
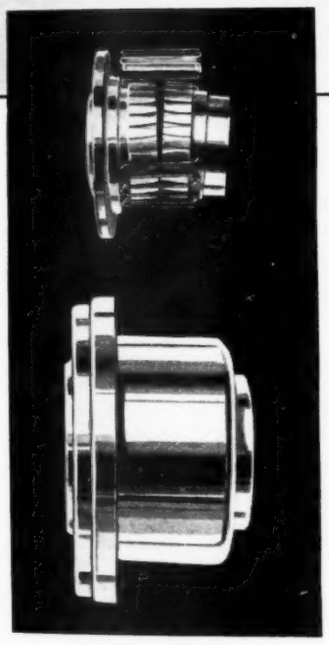


. . . Connecting 360 r.p.m. Oil Engine to Two Centrifugal Pumps at 1800 r.p.m.



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Cost Study of a DIESEL-ELECTRIC

IN the last few years the attention of the crude oil pipe line companies has been drawn to the economical possibilities of motor-driven centrifugal pumps. The application of this type of unit has, in the past, been limited to those regions that are served by electric power companies. Of course, in these days of super-power systems, electrical energy is available in practically all commercial areas, but pipe lines are sometimes built through undeveloped regions not yet served by power distribution systems.

The purpose of this article is to analyze the possibilities of building a power plant and transmission line along with the pipe line system traversing an area such as described above.

We shall not attempt to make a comparison of economies of the motor-driven centrifugal pump with any other type of pumping unit. These comparisons have often been made elsewhere. We shall assume that the motor-driven centrifugal unit is practical and will be economical where the power costs are within certain limits. For the purpose of this article we shall suppose that we are to transport 45,000 barrels of crude oil per day for a distance of 150 miles, assuming the viscosity of the oil to be 50 S. U. S., with a 34.96 A. P. I. gravity. For simplicity's sake, we will not take into account any difference of elevation along our line. In actual practice this factor would be met by adjusting distances between stations in accordance with local conditions. We shall also omit figures on costs of pipe line, right-of-way and tankage as these items would be common to all pipe line systems regardless of type of power used, and hence would affect the economies of any layout in the same degree. We shall assume that conditions are such that we will be assured of having a load factor of at least 85 per cent.

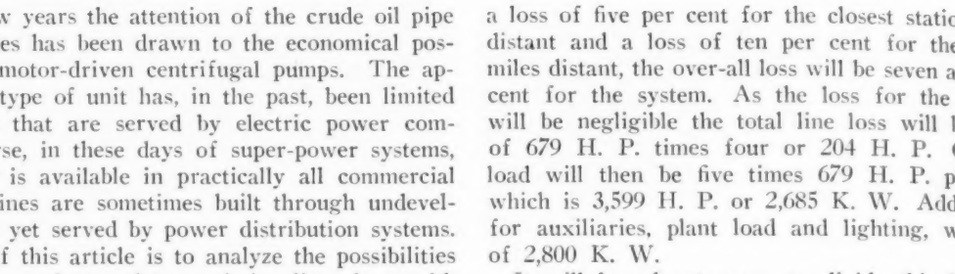


Fig. 1.

The number of stations required on this line will be governed by the pressure and capacity of our pipeline. Ten-inch pipe with a maximum working pressure of 700 pounds will offer the best economies for the conditions chosen. The pressure drop per mile for this size pipe handling 45,000 barrels per day will be 22 pounds. With five stations 30 miles apart the pressure at each station will be 660 pounds. The power required at each station will be 679 B. H. P. This figure is based on an efficiency of 93 per cent for the motor and 80 per cent for the centrifugal pump. With five stations equally spaced, our transmission line will be 120 miles long. By locating the power plant at the center of this line, as shown in Figure No. 1, our transmission line will have a virtual length of sixty miles each way from the power plant. The most economical transmission voltage for the above load and distance will be thirty-three kilo-volts.

In figuring the total horsepower required at our plant, we will have to allow for transmission line loss. Allowing a loss of five per cent for the closest stations thirty miles distant and a loss of ten per cent for the stations sixty miles distant, the over-all loss will be seven and one-half per cent for the system. As the loss for the central station will be negligible the total line loss will be 7.5 per cent of 679 H. P. times four or 204 H. P. Our total plant load will then be five times 679 H. P. plus 204 H. P., which is 3,599 H. P. or 2,685 K. W. Adding 115 K. W. for auxiliaries, plant load and lighting, we have a total of 2,800 K. W.

It will be advantageous to divide this load between at least five units. By dividing the load in this manner we will attain flexibility and will keep the size of the stand-by unit within reasonable limits. The flexibility is desirable in case of a decrease in pumping, for instance, 30,000 barrels per day can be handled with three stations. Based on a power factor of .80, our power plant will require five 700 K. V. A. machines plus one stand-by unit of the same capacity. This will be handled by 750-h.p. oil engines. The cost of the power plant will be as follows:

6—750-h.p. oil engines	$202,500
6—700 k. v. a. alternators and switchboards	49,000
Foundations (material)	16,800
Erection of engines, alternators and switchboards	9,500
Station building, cottages, water supply and all auxiliary machinery	200,000
Pumping units at central station	11,000
Total cost	$488,800

Pumping Stations

Each of the five pumping stations will require two 45,000-barrel capacity at 330-pound pressure centrifugal pumps connected in series and driven by 350-h.p., 2,200-volt induction motors. For the general arrangement of these stations, see Figure No. 2. The cost will be as follows:

2—350 H.P. motors and controls	$ 5,200
2—Centrifugal pumps	4,600
1—Sump pump and accessories	300
3—Cottages	6,000
1—Station building	2,000
Gates, piping and all fittings	2,000
Installation, lease, etc.	10,000
Cost one station	$30,100
Total cost—four stations	$120,400

Transmission Line and Substations

In computing the cost of the transmission line, we have not taken into consideration the purchase of right-of-way as this line will be built along the right-of-way already purchased for the pipe line. The cost will be as follows:

120 miles of 33 kilo-volt transmission line at $2,000 per mile	$240,000
Main substation	11,000
Four substations at $4,000 each	16,000
Cost of transmission line and substations	$267,000

Operated Pipe Line

By L. M. GULLESEN
A. A. HARDY,
The Prairie Pipe Line Co.

Total Costs

Power plant	$488,800
Pumping stations	120,400
Transmission line and substations	267,000
	$876,200

Yearly Costs of Operation

In figuring the yearly cost of operation we shall base our fixed charges on amortization in fifteen years. These charges will be as follows for the power plant:

Interest	6.0%
Depreciation	6.7%
Maintenance	3.0%
Taxes and insurance	2.0%
Fixed charges on power plant	17.7%

The fixed charges for the transmission line and pump stations will be the same as above except the item of maintenance, which, taken at one per cent instead of three per cent, will make a total of 15.7 per cent.

Based on a load factor of 85 per cent our total brake horse power hours for the year will be:

$3599 \times 24 \times 365 \times .85 = 26{,}800{,}000$ B.H.P. hours.

By using 18 degree Baume gravity fuel oil and with a consumption of .45 pounds of fuel per brake horse power hour, the yearly fuel oil requirement will be 37,000 barrels.

The yearly amount of cylinder lubricating oil used, based on a consumption of .8 gallons per 1,000 B.H.P. hours will be 21,440 gallons. The yearly amount of engine oil used, based on a consumption of .6 gallons per 1,000 B.H.P. hours, will be 16,080 gallons.

The yearly cost of labor at the power plant will be as follows:

1—Chief engineer	$ 2,700
3—Engineers at $2,220	6,660
3—Oilers at $1,980	5,940
3—Switchboard operators at $2,220	6,660
1—Machinist	2,400
1—Electrician	2,400
2—Helpers at $1,800	3,600
	$30,360

The men at the power plant will be expected to operate the pumping station at this point. This will leave four stations to be manned by three operators apiece, or twelve men at $2,100 each, which is a total of $25,200.

The total yearly cost of operation will, therefore, be as follows:

Fixed charges on power plant, $488,800 at 17.7%	$ 86,500
Fixed charges on transmission line and pumping station, 15.7% of $387,400	60,820
37,000 barrels of fuel oil at $0.40 per barrel	14,800
Lubricating oil (cyl.) 21,440 gallons at 55c per gallon	11,800
Lubricating oil (eng.) 16,080 gallons at 25c per gal.	4,020
Labor at power plant	30,360
Labor at stations	25,200
Total yearly cost of operation	$233,500

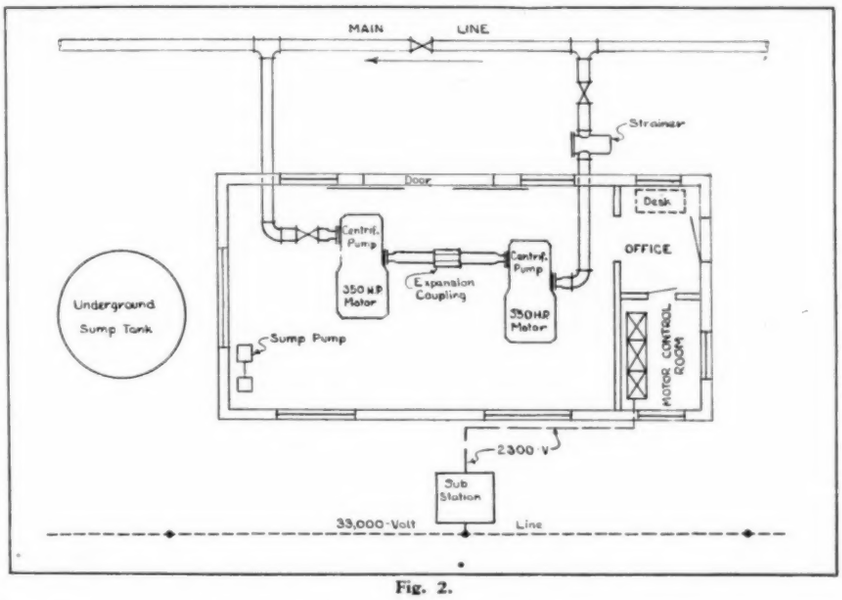


Fig. 2.

The total amount of oil pumped per year, based on the load factor of 85 per cent, will be:

$45{,}000 \times 365 \times .85 = 14{,}000{,}000$ barrels

The pumping cost per 1,000 barrels per station will therefore be:

$$\frac{233{,}500}{5 \times 14{,}000} = \$3.34 \text{ per 1,000 barrels per station.}$$

In computing the cost of energy delivered at the pumping stations we will, of course, base our figures on the cost of operation of the power plant, the transmission line and substations and will omit the cost of operation of the pumping stations. This will reduce our total operating cost of $233,500 to $189,380 per year. The total energy consumed by the five stations with their load of 679 H. P. each will be as follows:

$679 \times 5 \times .746 \times 24 \times 365 \times .85 = 18{,}858{,}260$ K. W. H. per year.

The cost per K. W. H. delivered at the pumping stations is, therefore:

$$\frac{18{,}938{,}000}{18{,}858{,}260} = 1.004\text{c per K.W.H.}$$

By using automatic equipment at the pumping stations the cost per barrel pumped would be somewhat reduced. The use of such equipment has attracted the attention of pipe line companies for the past year or two. Several installations of this type are now in use but there is a difference of opinion existing among authorities as to the practicability of leaving pumping stations which require comparatively large investments, without attendants.

Obviously each pipe line problem requires an individual analysis. It is quite possible that the conditions of one problem might be such that it would be impossible to attain ultimate costs such as shown here. However, another problem might present conditions that would lead to ultimate costs materially better than we have been able to show in this article.

In computing the cost of this system we have based our figures on current prices for materials and on standard practice. It is obviously possible to reduce some of the figures shown for analytical purposes in an article of this type, but it is our belief that our figures are conservative and could actually be used in practice. It would be perfectly possible to reduce some of the costs we have given and show, very logically, that the cost per K.W.H. would be eight mills but we believe that such figures, if actually applied would be found impracticable.

The Brewster Automatic Core Drill

The automatic feature is embodied on our regular Type M core barrel.

This automatic feature consists of a means of washing the inner barrel clean. The water is allowed to pass through this barrel until all foreign substances are washed out; when the operation of coring begins the ports in the inner barrel are automatically closed, allowing the fluid to pass around the inner barrel to the bit.

Another feature is the position of the valve in the top of the barrel, which is arranged to prevent the pressure from holding the ball down, so that in soft sand coring there is no resistance on the inner barrel, thus allowing soft sand cores to enter the barrel. A vent is provided to allow fluid and air to pass out of the inner barrel.

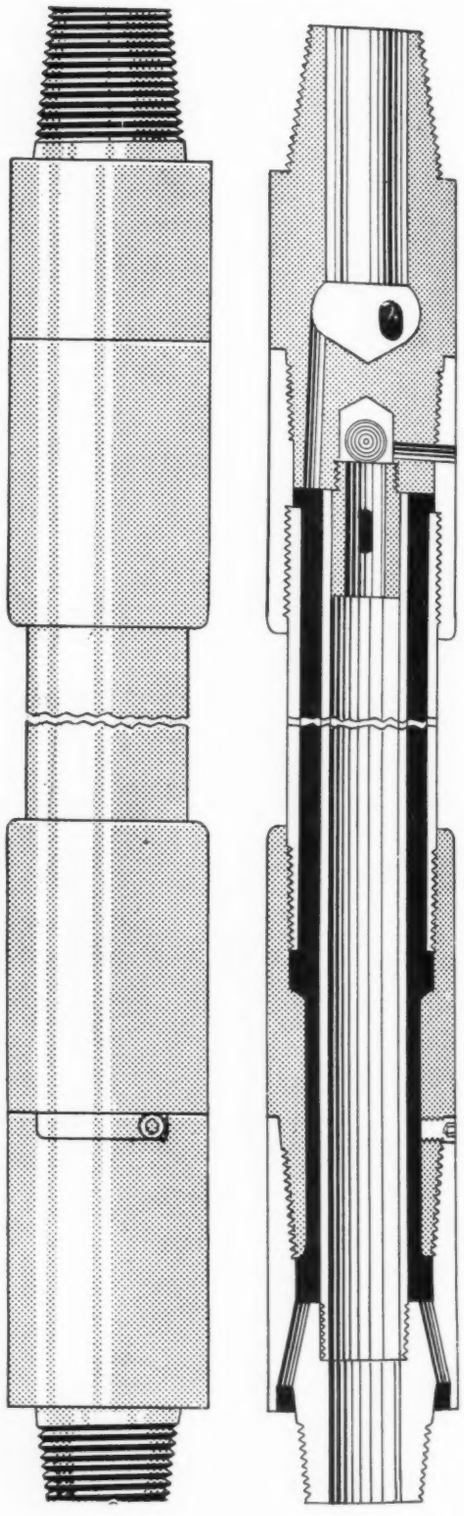
These features are very desirable and fill a long felt want where soft sand and other coring is necessary.

In either soft or hard formation a full recovery is assured. Made in all sizes and any length.

This barrel is equipped with split liners the same as Type C and Type M barrels.

The Brewster COMPANY~INC.
Shreveport,Louisiana

BUY FROM YOUR SUPPLY HOUSE

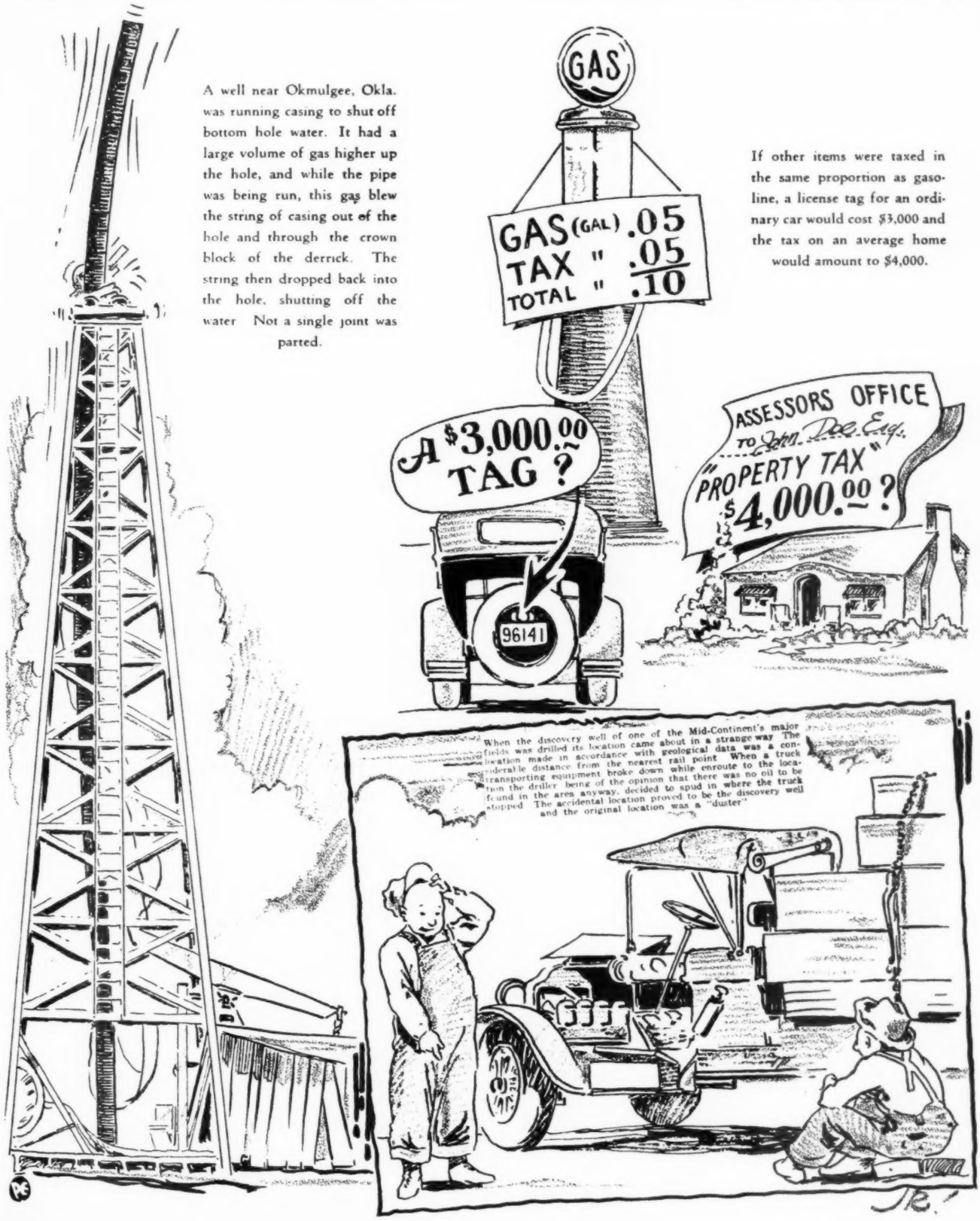


Exterior and interior view Brewster Type M Perfection Automatic Core Barrel.

Strange but True...

HAPPENINGS IN THE PETROLEUM INDUSTRY

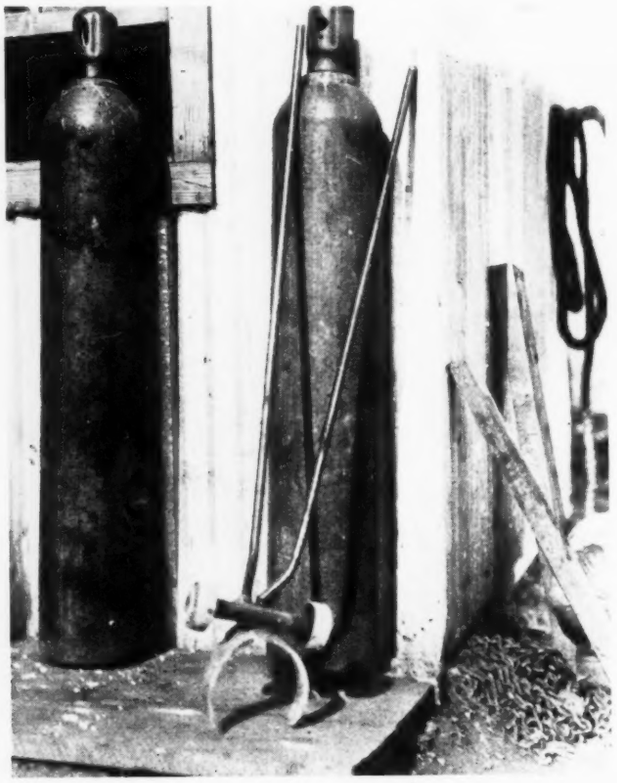
A well near Okmulgee, Okla. was running casing to shut off bottom hole water. It had a large volume of gas higher up the hole, and while the pipe was being run, this gas blew the string of casing out of the hole and through the crown block of the derrick. The string then dropped back into the hole, shutting off the water. Not a single joint was parted.


GAS
GAS (GAL) .05
TAX " .05
TOTAL " .10
A $3,000.00 TAG ?
96141
ASSESSORS OFFICE
TO John Doe, Esq.
"PROPERTY TAX"
$4,000.00 ?
When the discovery well of one of the Mid-Continent's major fields was drilled its location came about in a strange way. The location made in accordance with geological data was a considerable distance from the nearest rail point. When a truck transporting equipment broke down while enroute to the location the driller being of the opinion that there was no oil to be found in the area anyway, decided to spud in where the truck stopped. The accidental location proved to be the discovery well and the original location was a "duster"

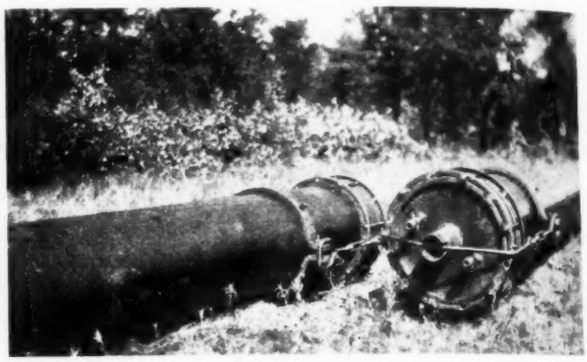
If other items were taxed in the same proportion as gasoline, a license tag for an ordinary car would cost $3,000 and the tax on an average home would amount to $4,000.

TIME *and* TROUBLE SAVERS

Handling large heavy drilling bits in the furnace is accomplished with ease by means of a pair of small pulleys or rollers attached to one leg of the tongs as shown in the accompanying illustration. Tongs thus equipped were observed in use at the Placential Welding Company's shop in the Oklahoma City field.

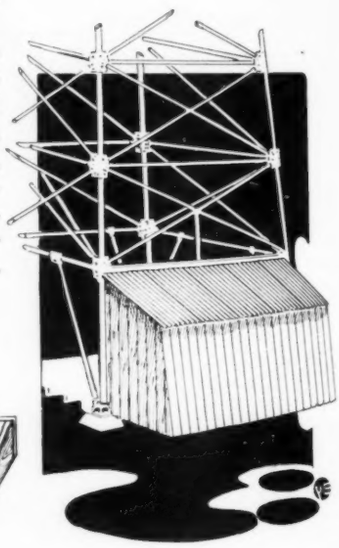


To facilitate line testing Elden Glenn, with the Lone Star Gas Co., designed the illustrated plug made with a standard sleeve coupling. A standard coupling was used with a blind plate welded in one end. It has two connections, one for inlet of pressure and one for safety. It is bolted together and made secure with the use of a tie rod running around it and connecting to a D link.

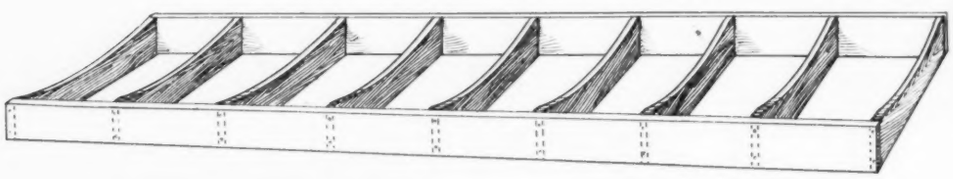


The D link is attached to a band bolted to the pipe. It is made with 2½-inch metal and in halves. Four set screws, two in each half, were put in the band and with these the band is made to hold more rigidly. Small hump welds may be made on the pipe and the band permitted to pull tight against these. The tie rod is tightened to the D link with a turnbuckle.

Weather protection for bull wheels left in place on pumping rigs as pulling equipment is provided by The Empire Oil & Refining Company in the El Dorado, Kansas, district. A shed of wooden or sheet metal construction is built to cover the part projecting outside the derrick.

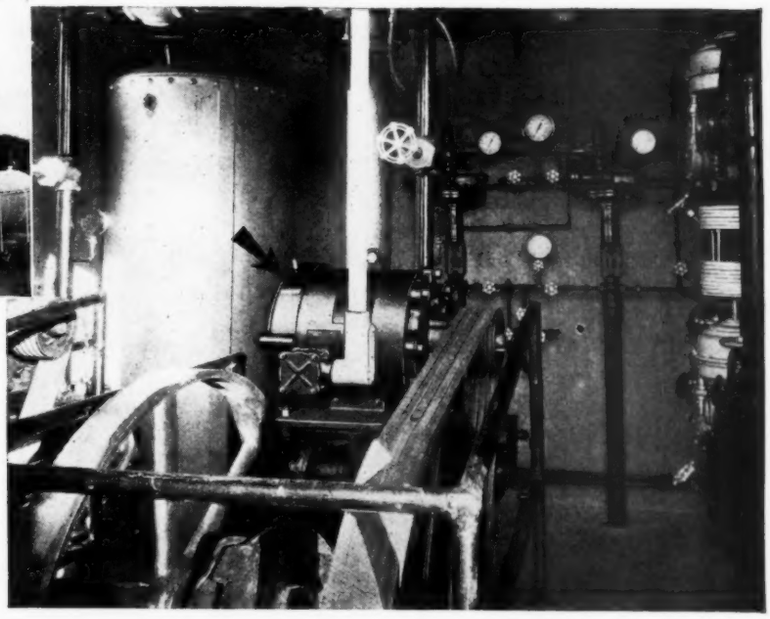


Sucker Rod Truck Bed

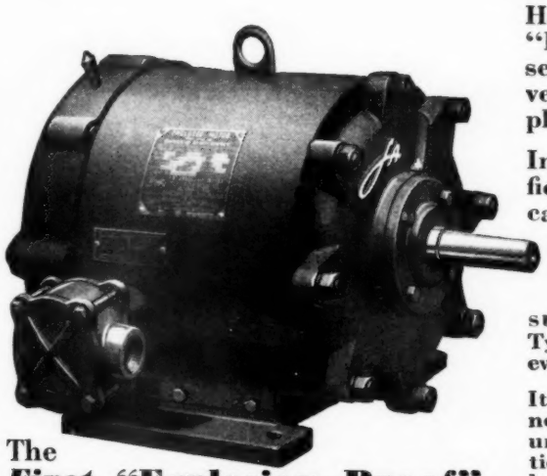


Injury to sucker rods while hauling them through the fields by permitting them to droop over the end of the truck bed and drag on the ground has been eliminated by the Gypsy Oil Company in the Seminole, Oklahoma, district. A sucker rod truck bed of wooden construction has been made. The bed is long enough to carry the entire length of the rod and is set on an ordinary truck bed. A carriage rack of this type may also be constructed of welded pipe.

Skelly Oil Co. "bottled gas" or "liquid carburetion" plant at Spencer, Iowa . . . one of this company's many plants for making Skelgas . . . where 2 air compressors are driven by Louis Allis "Explosion-Proof" motors.



Bottled Gas Plant Protected *with* Louis Allis "*Explosion-Proof*" Motors



The *First* "Explosion-Proof" Fan-Cooled Motor...L.A. Type E

Tested and Approved by Underwriters' Laboratories for use in Class I. Group D hazardous locations, that is wherever petroleum products, alcohol, ethyl acetate, and equally hazardous liquids are made, used, or handled.

¼ to 150 HP.

Here is one of the new and interesting "Bottled Gas" or "Liquid Carburetion" plants, that are now bringing gas service to many towns previously denied this modern convenience due to being located too far from sources of supply of natural or manufactured gas.

In this plant the finished gas is made from butane, a liquified petroleum gas, by vaporizing the liquid butane and carbureting with air from two compressors. The two compressors are equipped with Louis Allis Type E "Explosion-Proof" motors, because the designing engineer realized that in case of gas leaks the motors would be surrounded by explosive vapors. Consequently, the L.A. Type E motors *protect* this plant from the fire hazard incurred wherever non-approved motors operate in explosive atmospheres.

It was the L.A. Type E motor that first made possible the direct connection of approved motors to compressors, pumps, fans, centrifuges, unit heaters, etc., in explosive atmospheres . . . *without* the conventional fire wall. Now L.A. "Explosion-Proof" motors and starters are being used all over this country and in many foreign countries in chemical plants, oil refineries, natural gasoline plants, bulk stations, terminals, pumping stations, and dry cleaning plants.

Stop guessing at safety! Follow the leaders—*standardize* on Louis Allis "Explosion-Proof" motors and starters.

WRITE FOR COMPLETE INFORMATION

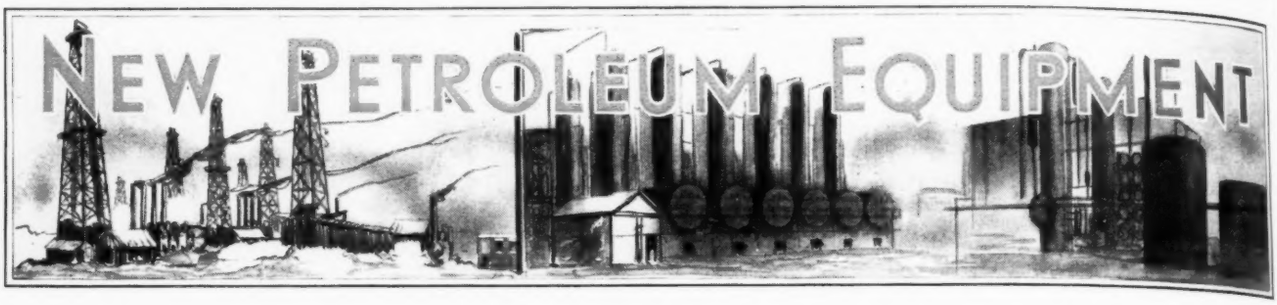
LOUIS ALLIS

"EXPLOSION-PROOF" *Electric* MOTORS

THE LOUIS ALLIS COMPANY
MILWAUKEE, WIS.

Motor Specialists Since 1901 — *Offices in Principal Cities*

Sales Offices: Tulsa, Houston, Shreveport, St. Louis, Chicago, Detroit, Cleveland, Pittsburgh, New York, Philadelphia, Boston, Buffalo, Los Angeles, San Francisco . . . and other principal cities.



New BJ Tubing Hooks

A NEW BJ Tubing Hook is being offered in two sizes, the BJ "50" with a safe load capacity of 50 tons, and the BJ "75" for 75-ton loads.

Byron Jackson Engineers consider that a hook designed and built for handling tubing is safer and more efficient in operation than the present custom of using a large size rod hook for short strings of tubing and a small casing hook for longer strings.

In common with other new BJ Hooks, both of these tubing hooks are equipped with a patented locking arm which in the open position extends outward from the bill of the hook thus serving as a guide to facilitate picking up the elevator bails. This locking arm closes and locks automatically when the load is taken and the possibility of elevator bails jumping clear of the hook is eliminated. A further, and perhaps the most important, feature of this locking arm is that it connects the bill of the hook with the body to form a closed link, thus producing load-carrying and shock capacity not possible in an open type hook of equal dimensions, the makers state.

Not only do these hooks automatically lock when the load is taken, but they cannot thereafter be unlocked except by the operator, and not fully opened until the load is removed. This safety feature will particularly appeal to many operators who have experienced accidents with other types of hooks where these safety devices are not included.

The balanced construction, safety features and ease of operation of these hooks may be visualized from detailed literature which will be forwarded upon request by Byron Jackson Co., P. O. Box 1307, Arcade Station, Los Angeles, California.

Utility Six-Wheel Truck Attachment

UTILITY six-wheel attachments are being sold by the Leland Equipment Company of Tulsa and Oklahoma City, Okla. These attachments distribute the load over more axles, wheels and tires, which reduces road shock and saves tires as well as highways, operation cost and operation time, the Leland people state.

A four-wheel truck is limited to 20,000 pounds gross, but with the attachment providing an extra axle, the State Highway Department permits it to carry 26,000 pounds gross by special permit, and when equipped with a trailer its permissible gross is 42,000 pounds.

The Leland Equipment Company, in addition to selling these six-wheel attachments, also installs and services the units.

Automatic Gauge for Butane Tanks

THE Vapor Recovery Systems Company of Compton, Calif., announces a new Automatic Tank Gauge for Butane Tanks.

Frank V. Long, president, states: "Gauging of liquid gas, because of the high pressures which must be maintained within the vessels, has presented many problems and hazards which are all eliminated with the new "Varec" Liquid Gas Gauge.

"Contents in the tank is given in feet and inches at the ground or may be at some remote location.

"All fittings are tested at twice the working pressure, the gauge tape being visible through a plate glass window. Each moving part is noncorrosive and is easily accessible.

"These gauges have been used on tanks maintaining 50 pounds gauge pressure and two have recently been installed where 250 pounds gauge was the working pressure. In cases of 250 pounds pressure, gate valves may be installed over the look box glass as an additional safety factor without interfering with the view of the tape.

"The method of construction lends itself to varying requirements and may be had for any working pressure."

The Axelson Liner Insert Pump

The eleventh of a series and the second advertisement on Liner Insert Pumps

STRAIGHT FACTS

Calculate

your cost per barrel of pumped oil

Today economical production has passed the point of desirability and reached that of necessity. Wise operators figure it three ways: First, on the basis of increased yield; second, by maintenance cost; third, through operating data. Here is an example; any Axelson representative will show you dozens more.

Record No. 2

A 2½" x 12" traveling tube liner insert pump installed at 5828 ft. started production at 130 bbls. as against the initial production of 90 bbls. of the pump it replaced. This pump has produced 130 bbls. a day for over 5 months and has never been removed from the hole.

Record No. 15

A 2½" x 12" traveling tube insert liner pump replaced a cup type insert pump producing 156 bbls. of 18 gravity oil. The Axelson pump produced the same volume of oil under the same conditions, but used only 1½ h. p. for pumping as against 7 h. p. on the cup type pump.

From 90 to 130 barrels,—that's increased production. Five months' continuous pumping—that's low maintenance. From 7 h. p. to 1½ h. p. pumping load—that's minimum operating cost. Put them all together—you have the reason Axelson Pumps are reducing the lifting costs of oil in every field.

Axelson products include pumps, sucker rods, valves, fittings, pull rods, stuffing boxes and other production equipment.

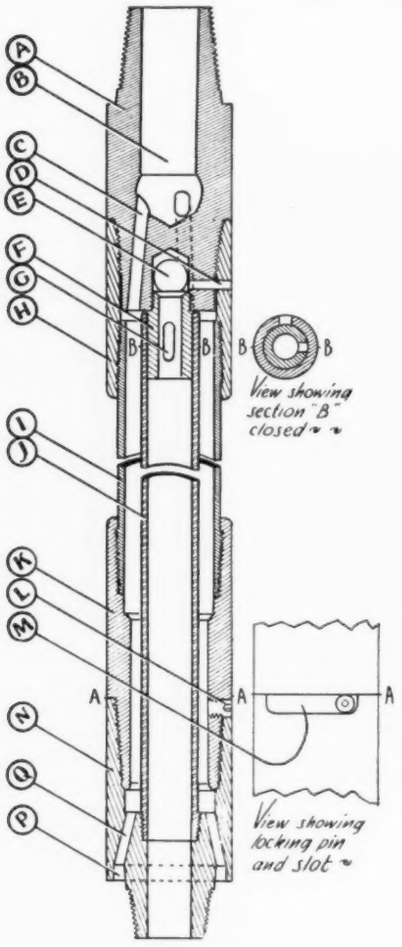
AXELSON MANUFACTURING CO., Ltd.

P. O. Box 337, Los Angeles
Tulsa St. Louis
New York City, 30 Church St.
Mid-Continent and Eastern Distributors
FRICK - REID SUPPLY CORPORATION

A MANUFACTURERS SINCE 1917
THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

When writing AXELSON MANUFACTURING CO., LTD., *please mention The Petroleum Engineer*

Brewster Automatic Core Barrel



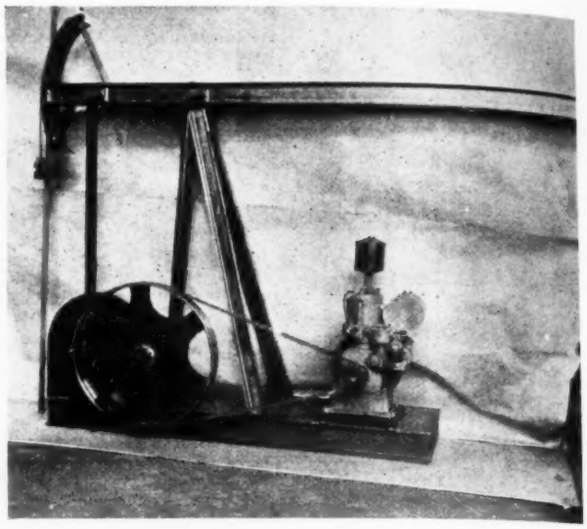
THE Brewster Company, Inc., Shreveport, La., announces the manufacture and sale of an automatic core barrel, the purpose of which is to go in and wash the barrel thoroughly before reaching bottom; as the port G (see illustration) is open when entering the hole, allowing the water to pass through the inner barrel and enabling the operator to go through bridges or other objects before reaching bottom and then thoroughly cleanse the barrel before taking a core. The locking pin on the bottom of the barrel, marked L, showing a cross-section view of M enables the barrel to be set at one position when starting in the hole, thus opening the port in the inner barrel marked J.

After thoroughly washing, the core barrel is set down on bottom of the hole and the lower section of the barrel, Marked N, will automatically transfer to the point marked M, thus closing the upper valve. It will be noted from the accompanying sketch that longitudinal ducts, or water course holes, are provided through the upper sub marked A, and also that the ball and seat are independent of the barrel and are in no way affected by the pressure of the fluid, as the ball and seat are placed in the sub. As the core follows up the inner barrel, the ball is raised off of the seat and the air and fluid pass out the side of barrel at port D without any resistance.

Intermittent Duty Single Well Pumping Unit

A NEW intermittent duty single-well pumping unit has been developed and placed on the market by the American Crane Co., Inc., of Friendship, N. Y.

The construction is of all steel, electrically welded throughout. Main base frame built up of channels and plates and sampson post built up of channels and tee bar together with the shaft bearing retainers is of one single unit. The walking beam is composed of two channels with the bearing in the top of the sampson post mounted between the channels and the bearing for the upper end of the connecting rod also mounted between the channels. The two channels are welded together by connection plates and the semi-circular polish rod guide with the self-equalizing cable support, all welded solid to the beam. This construction of beam with high-grade steel hoisting cable connection to the cross bar carrying the polish rod clamp is the most flexible and effective means of connection to the polish



rod in a manner to insure the pull of the rod in perfect alignment with the stuffing box.

The machine is built with belt drive, with ample space for mounting any ordinary type of gas or gasoline engine or electric motor, or it may be furnished without power, arranged for belt drive from some external source.

Hills-McCanna Tensiometer

THE Tensiometer, manufactured by Hills-McCanna Co., Chicago, is built for service in the field. Its heavy aluminum case, and all exposed parts, are chromium-plated or made of stainless steel. The weight is only fourteen pounds; the over-all dimension, two and one-half feet, which enables easy handling and use in many positions and places. The standard model will test all wires and ropes up to one inch in diameter and has a tension capacity of 16,000 pounds. Larger capacity meters and meters for special shaped stream line aeroplane cables can be supplied. The instrument is unusually sensitive and will register the slightest change of tension while in place. This extreme accuracy also permits its use for weighing.

In the petroleum industry it is used for determining the pull on a cable when the drill is stuck, and preventing a greater pull being exerted on the cable than is safe. The meter is also used for fishing and to record graphically the weight of the drill at all times.

The Tensiometer is simply hooked onto the wire in any position and the center bearing tightened, which deflects the cable. A correct reading is given at once. The whole operation takes less than a minute. The reading is taken directly from the scale in pounds; there are no calculations or temperature corrections to make. There are no liquids, glass or loose parts to cause trouble. No wrenches or tools are required in its operation, enabling workmen, dressed for severe cold weather, to use the meter without trouble.

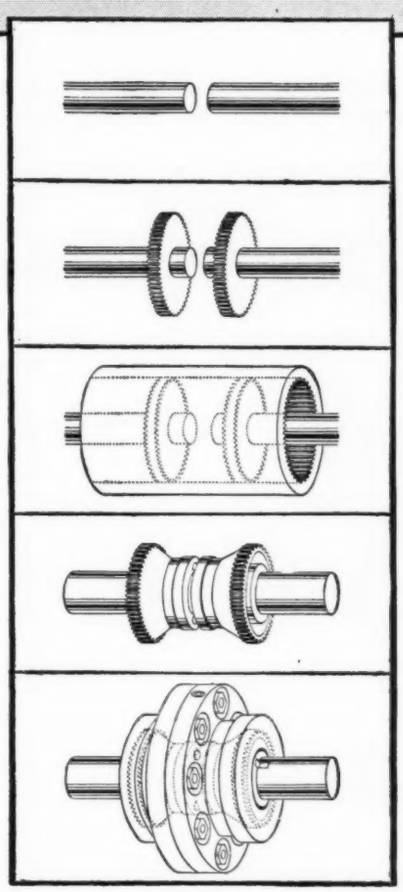
The How and Why of FAST'S COUPLINGS

SEE the sketches showing the development of Fast's shaft coupling design. Two simple mechanical principles are used. *First, Fast's principle entirely eliminates flexible materials.* Two spur gears are in complete and continuous mesh with the internal gears of a floating sleeve. *Second, the coupling is "double engagement".* There are two compensating units—one at each shaft end, the central section of the coupling taking a neutral position. Thus any form of misalignment is compensated for without crank action or vibration.

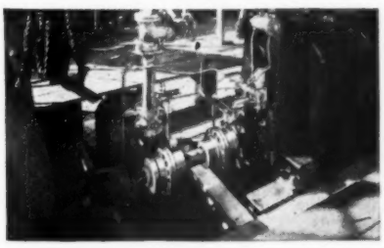
The entire assembly rotates as one unit, the misalignment being taken up between the lubricated gear teeth. The casing is filled with oil. As the coupling revolves, the oil is distributed between the gear teeth by centrifugal and capillary action. Furthermore, due to the all-metal bearing ring design, the coupling is definitely dust-proof and will operate continuously in dust, fumes, and moisture. There is no felt, rubber or other such materials to wear and let in dust and grit.

Power flows smoothly and steadily from the motor to the producing machine. Production tie-ups due to coupling or other connection failures are eliminated. Fast's Couplings become part of your permanent transmission equipment and with the same care will last as long as the connected machines.

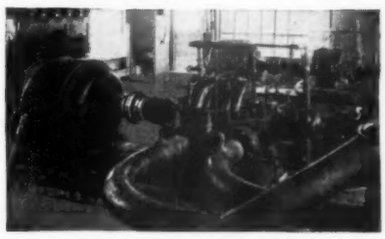
Mail the coupon below for free copy of the new bound catalog telling the how and why of Fast's Self-Aligning Couplings. No file is complete without one.



FAST'S *Self-Aligning* COUPLINGS



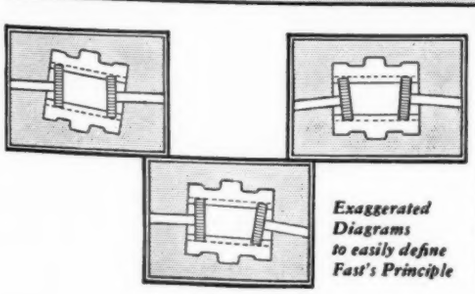
Fast's Couplings at Mitchell Drilling Company, Oklahoma City, Okla.



Fast's Coupling at Oklahoma Pipe Line Company, St. Louis, Oklahoma

Fast's Coupling at Magnolia Petroleum Corp., Wewoka, Oklahoma

NO FLEXIBLE MATERIALS



Exaggerated Diagrams to easily define Fast's Principle

THE BARTLETT HAYWARD CO.
244 Scott Street » « Baltimore, Md.

Send me free bound copy of Fast's Self Aligning Coupling Catalog showing varieties of designs and installations, and containing valuable data on coupling installation.

Name _____

Firm Name _____

Address _____

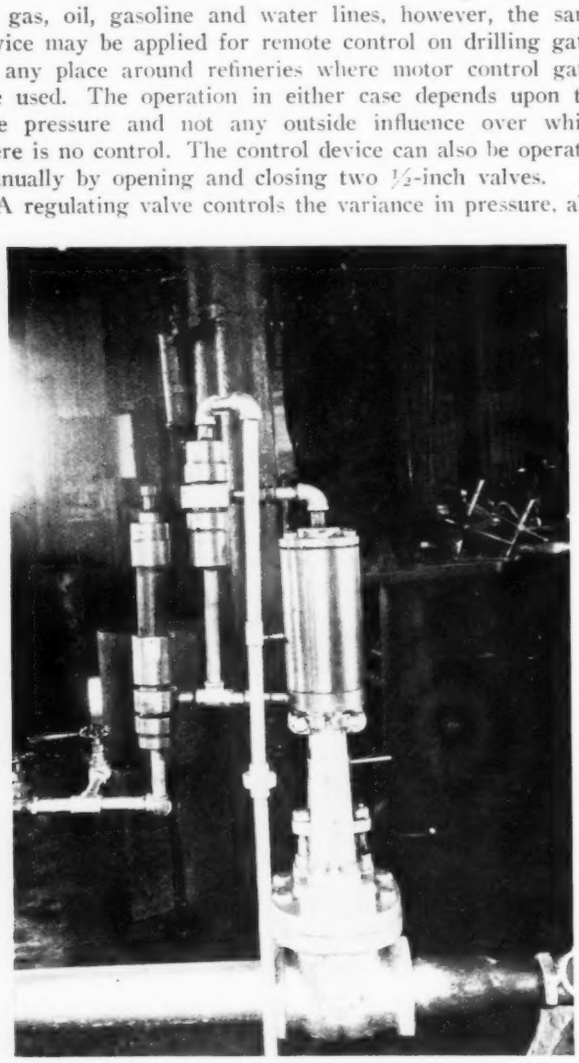
When writing THE BARTLETT HAYWARD CO., *please mention The Petroleum Engineer*

Wait Automatic Valve Control

AN AUTOMATIC valve control which automatically closes the gate valve in case of a line break and automatically opens the valve after the break has been repaired has been designed and invented by C. L. Wait and L. L. Wait, 1536 South Detroit, Tulsa. The valve control will shortly be placed on the market.

The control can be placed on old valves now in use or on new valves about to be installed. It is designed for duty on gas, oil, gasoline and water lines, however, the same device may be applied for remote control on drilling gates or any place around refineries where motor control gates are used. The operation in either case depends upon the line pressure and not any outside influence over which there is no control. The control device can also be operated manually by opening and closing two ½-inch valves.

A regulating valve controls the variance in pressure, also



regulates the speed with which valve opens and closes and eliminates possibilities of the valve sticking or freezing. The unit will permit the valve to act as a relief valve, opening and closing if the pumps continue to run.

As the line content pressure enters under the regulating valve it is stored in a power reservoir containing the same pressure as in the line and retains the same pressure after break has occurred. As pressure enters the regulating valve it also enters reversing valve, allowing the pressure in the reservoir to enter on top of piston, closing the valves.

Loadmaster Revolving Crane on Trackson Crawler

THE adaption of the Loadmaster Crane, manufactured by Frederic H. Poor, Inc., New York, to the Model GH Trackson McCormick-Deering Crawler fulfills a need for a revolving crane on crawlers. This unit provides a convenient and economical method of lifting, carrying and spotting heavy weights and unwieldy objects.

The bull wheel for swinging the boom is power-driven, and is equipped with a brake so that the boom may be set at any angle desired over the front or sides of the tractors. The speed of the boom's swing is controlled by the operator.

With the standard 10-foot boom the Loadmaster has a maximum lifting height of 12 feet 4 inches under the hook; with the boom lowered, it has a maximum outreach of 10 feet from the center of the mast in any direction. Where unusual conditions require a higher lift or greater outreach

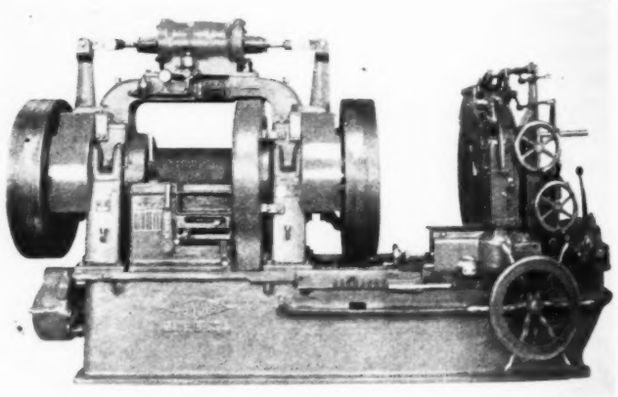
special booms can be furnished by Frederic H. Poor, Inc.

An important feature of the equipment is the fact that the crane does not interfere with the use of the tractor for drawbar work, and it is therefore an all-around versatile power unit as well as a convenient portable crane. Write the Trackson Company, 1320 So. First St., Milwaukee, Wis., for additional information about this equipment.

Pipe-Threading and Cutting Machine With Air-Operated Chucks

THE Landis Machine Co., at Waynesboro, Pa., is now offering an 8⅝-inch pipe threading and cutting machine equipped with air-operated chucks.

This attachment insures a powerful grip with practically no effort on the part of the operator and eliminates the



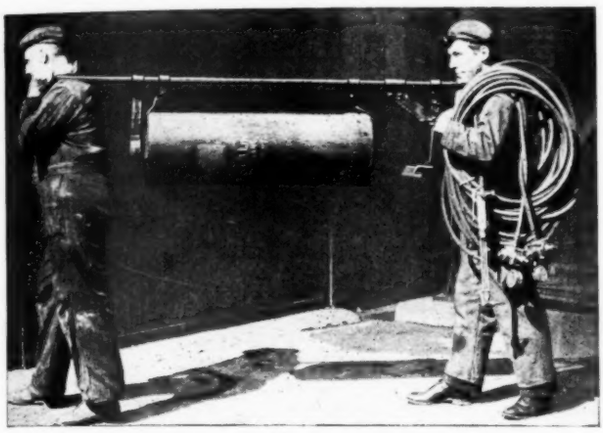
possibility of the grips loosing their hold on the pipe during the threading operation.

The attachment is controlled by a four-way valve which automatically returns to the neutral position when the operator removes his hand from the control lever. Air consumption is said to be exceedingly low.

Safety Cylinder Carrier

THE Carbo Safety Cylinder Carrier, manufactured by Union Carbide Co., New York, consists of several members, the main one being a supporting beam constructed of standard steel pipe to one end of which is permanently attached a ring or collar constructed of ⅛"x 2" flat steel designed to hold the valve end (cap attached) of oxygen or similar type cylinders. The means of supporting the other end of this type cylinder is a specially designed forked hook constructed of ¼"x 1½" flat steel, the upper end of which is attached to the hinged end portion of the supporting beam. This hook, which has two supporting lugs, is brought into place under and back of the base end of the cylinder to be carried by applying an upward lift to the hinged end portion of the supporting beam, the cylinder being released by reversing this action.

For carrying the Prest-O-Lite type of acetylene cylinder



two swinging hooks constructed of ¼"x 1¼" flat steel are provided. These are attached to the middle section of the supporting beam. They engage the rims of the concave top and bottom of this type cylinder. The forward hook is permanently fixed on the supporting beam while the other hook is slid along the beam to the desired point and then tightened in place. To prevent this hook from changing its position, a safety clamp is tightly attached to the supporting beam back of the sliding hook.

When "Carbo" type acetylene cylinders are to be carried, the ring or collar previously mentioned for use with oxygen type cylinders supports the valve (or top) end of the cylinder while the sliding hook and safety clamp is moved forward along the supporting beam to the required position and tightened in place. The sliding hook engages the rim of the base of this type cylinder.

New Type Oxweld Goggles

THE Linde Air Products Company, 30 East 42nd Street, New York, N. Y., has recently introduced a new type of welders' goggles, designated as Oxweld No. 12 Goggles. This improved type embodies features never before found in safety appliances of this kind.

Absolute comfort is assured since they are designed to fit the eyes and are adjustable to conform to the individual nose. The edge of the cup coming in contact with the face is shaped to conform to the general contour of the welder's cheekbone and nose, thus fitting smoothly around the eyes.

The eye-pieces are joined with a leather strap, adjusted by means of a metal buckle, so that they may be correctly spaced to the width of the face.

Ventilation has been carefully considered in designing these goggles. Patented ventilation ports on each side of the eye-cups are so constructed that it is impossible for sparks or light to reach the inside of the cup. The depth of the cup is another feature, permitting ample circulation of cool air.

The field vision has been increased by the use of 50 mm. diameter lenses instead of the usual 47 mm. lenses. Brown

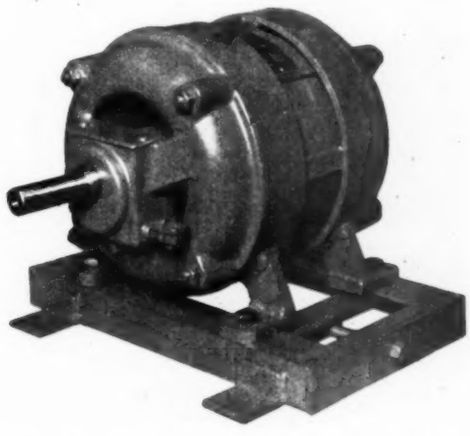
color lenses, known as the "B" type, are available as with older type goggles and in addition, a new special quality green lens, known as the "A" type, is available in three different shades. Lenses may be easily changed by simply removing the metal cups which unscrew from the frames of the eye-pieces.

The material of which these goggles are made differs from that used in any other eye protector. It is a molded plastic substance known as Oxweldite which is formed over a fabric base and is resistant to heat, light and electric current. The entire construction of these goggles is such that they will readily withstand the usage to which goggles are subjected in welding shop or plant.

Lincoln Electric Motor Base

THE Lincoln Electric Company, Cleveland, Ohio, manufacturers of "Linc-Weld" motors and "Stable-Arc" welders, recently announced the manufacture of a welded steel motor base of one-piece construction.

These new bases are designed to be used instead of slide



rails. They are constructed of rolled steel angles and flat bar stock fused into one homogenous unit by the electric arc. The flanges of the flanges to which the motor is bolted are slotted to permit moving the motor on the base for purpose of tightening the drive belt. At one end a screw adjustment is provided for moving the motor on its base in such cases.

RUNNING TOUR With Men In The Industry

A. W. Ambrose

A. M. Ambrose, vice-president and manager of the oil production division and the geological and land departments of the Empire Companies, has been made assistant general manager of the organization, according to an announcement made by H. R. Straight, vice-president and general manager. He had varied experience before joining the Empire companies in 1923.

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A. B. Vanhooser, farm foreman for the Humble Oil & Refining Company, has been transferred to Beeville, Texas, from Luling, Texas. Mr. Vanhooser is now working in the Pettus oil field.

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W. G. Jensen of Coffeyville and E. H. Jensen of Tulsa, both with the Jensen Bros. Mfg. Co., have been spending considerable time in the East Texas fields.

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W. R. Brown, purchasing agent of the Mid-Kansas Oil & Gas Company, Tulsa, and Miss Faye Teeter of Fort Worth, Texas, were married the latter part of May. The many friends of the couple wish them continued happiness.

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Glenn L. Shepherd, previously refinery engineer for Empire Oil & Refining Company, Tulsa, is now located at Cleveland, Ohio, where he is connected with the Arthur G. McKee Company as engineer.

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Charles H. Keplinger, graduate in engineering, University of Tulsa, 1931, is in the East Texas field doing research work for the National Tank Company, Tulsa.

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William Ray of the Magnolia Petroleum Company has been transferred from Wirt, Oklahoma, to Wewoka, Okla., where he is plant superintendent.

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Cliff Wright

Clifford E. Wright, district petroleum engineer, Indian Territory Illuminating Oil Company at Oklahoma City, is the proud father of a new-born baby boy.

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Vincent Glick, formerly pipe line foreman for the Sinclair Oil & Gas Company at Seminole, Okla., is now at Garber, Okla., where he is main line foreman.

Robt. W. Ducker is back at his former home at Tecumseh, Okla., after spending several years as chief engineer for the Standard Oil Co. of Venezuela.

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Robt. W. Ducker

R. T. Ogilby of the Fluid Packed Pump Company, Los Nietos, Calif., has been a recent visitor to Tulsa. Mr. Ogilby is connected with the rodless engine department of the company, and in company with John Moran, of the Oklahoma City office, looked into the operating conditions in the Mid-Continent.

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Frank Coates, of Henry L. Doherty & Company, has been elected to the board of directors of the American Petroleum Institute, to succeed H. L. Doherty, resigned.

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H. E. Zoller, formerly petroleum engineer for the Comar Oil Company in the Tonkawa, Oklahoma, field, has been transferred to East Texas, where he is district engineer for the Shell Petroleum Corporation. Mr. Zoller is making his home at Kilgore, Texas.

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James R. Cole, president, The Producing Equipment Company, Tulsa, has been on a trip through Texas, including a visit to the East Texas oil fields, where he called upon the trade. He was accompanied by his wife.

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Elmer Schmidt, general superintendent, and Julian Foster, chief engineer, Lone Star Gas Company, Dallas, were business visitors in Nebraska recently.

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R. R. McGuire, previously general superintendent of the Elwood Exploration Company at Goleta, Calif., is now with the Honolulu Oil Corp., at Goleta.

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Frank Carr of the Leland Equipment Company, Tulsa, has been in East Texas in the interest of his company.

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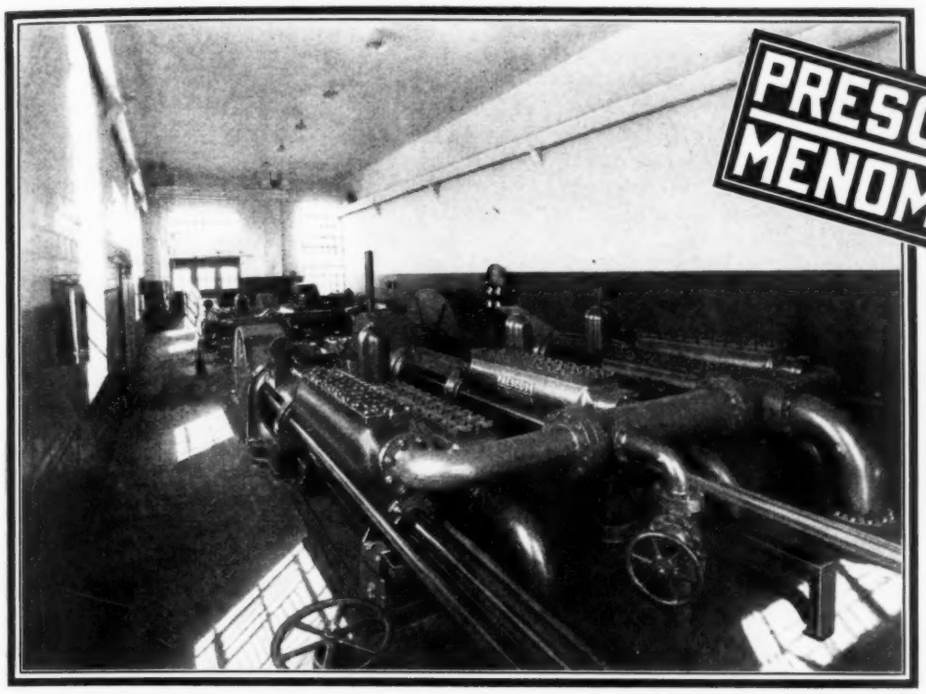
Frank Carr

R. A. Turner, formerly assistant production engineer with the Magnolia Petroleum Company, Dallas, is now with the Standard Oil Co., of New York, in the capacity of chief engineer of main line stations. His headquarters are at Rineiside, R. I.



2—6" x 36" Prescott Horizontal Triplex Plunger Pumps. Daily capacity, each pump 36,000 Barrels. Main Line of Prairie Pipe Line Co., Shawnee, Oklahoma.

The PRESCOTT Guarantee is "built in"

CORRECT design, highest quality of materials, and careful manufacture constitute the only worthwhile guarantee of permanent satisfaction, and the widespread preference of pipe line operators for Prescott Reciprocating Plunger Pumps is the result of our adherence to those fundamentals.

"Prescott pumps have earned an enviable reputation for dependability and economy. Varying loads do not affect their efficiency."

"Prescott pumps are built for either oil or gasoline — any capacity — any pressure — any type of drive."

THE PRESCOTT COMPANY

Menominee, Michigan, U. S. A.

PRESCOTT PUMPS PREDOMINATE

When writing THE PRESCOTT COMPANY, *please mention The Petroleum Engineer*

Tom Jones

Tom Jones, of the Oklahoma Contracting Company, Dallas, Texas, has returned from a business trip that carried him into Illinois.

C. L. Butchee, district superintendent, Houston Oil Company of Texas, has moved from Beeville, Texas, to Robstown, Texas.

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E. L. Decker and Harvey Martin of the Martin-Decker Company were recent visitors to the Mid-Continent.

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M. B. MacNeille has joined the sales organization of the Dayton-Dowd Company, Quincy, Ill., and will act as western sales manager with headquarters in San Francisco. Prior to his affiliation with the Dayton-Dowd Company, Mr. MacNeille was for nineteen years connected with the pump division of Fairbanks, Morse & Company.

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Alvin Zwerneman has recently been promoted to director of sales in the California division for the Axelson Manufacturing Company. Mr. Zwerneman has been in the oil well equipment business for the past twelve years, nine of which he has been with the Axelson Company. Ray Humphreys has been promoted to the position of assistant to Mr. Zwerneman.

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R. C. Brandon, drilling superintendent for the Sinclair Oil & Gas Company, has moved his residence from Covington, Okla., to Oklahoma City.

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H. M. Arthur of Shreveport, La., formerly general superintendent of the El Dorado Pipe Line Company, is now in the same capacity with the Atlas Pipe Line Company.

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Otis Hanner is now chief engineer for the Kengreen Gas Utilities Corporation, with headquarters at Corbin, Ky. He was previously in the same position with Central Gas Corporation, with residence at Henderson, Ky.

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Blaine Johnson, formerly located at Smackover, Arkansas, for the Simms Oil Company, has been selected to succeed Warren L. Todd, resigned, as vice-president in charge of production. Mr. Johnson will make Dallas his headquarters.

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Henry Likes, formerly vice-president of the Fulton Iron Works Company, St. Louis, Mo., recently was made manager of the Special Sales Division of The Medart Company, St. Louis. Almost simultaneously with word of the new connection came the announcement of the arrival at the home of Mr. Likes of a baby girl, born on June 19.

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P. C. Jones, president of the S. M. Jones Co., in Toledo, Ohio, has just completed a tour of the Mid-Continent oil fields.

Alvin Zwerneman

Clyde Ellwood, vice-president of the Axelson Manufacturing Company, Los Angeles, Calif., sailed for Europe where he will make a survey and sales trip in the interest of his company, and also as representative for Martin-Decker Corp., Ratigan and Kobe companies.

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John Franklin Dodge, professor of petroleum engineering and chairman of petroleum engineering, University of Southern California, was a recent Tulsa visitor. He is touring the nation's oil fields with his family this summer. From the Mid-Continent he will continue east.

Clyde Ellwood

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A. I. Brainard, president of the Beaumont Iron Works of Beaumont, Texas, has been a recent visitor in the Tulsa trade territory.

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D. Baker, drilling superintendent, Olson Drilling Company, has moved from Shawnee, Oklahoma, to McPherson, Kansas, where his company is drilling a number of wells.

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R. D. Bean, formerly manager of the engineering development department of The Brown Instrument Company, Philadelphia, has been made chief engineer of that company.

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O. E. McClatchey, purchasing agent, Barnsdall Company, with headquarters in Tulsa, was a recent visitor to the East Texas oil fields.

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H. H. James of DuPont de Nemours & Co., Inc., has returned from a ten-day visit to Beaumont, Texas.

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Myron M. Kinley, of M. M. Kinley Co., Tulsa, and famous as an oil well fire shooter, is now in Europe. He attended the Rotary International meetings at Vienna, Hungary, from June 21 to 26th, inclusive, where he represented the Tulsa Rotary Club. Mr. Kinley is making the trip as a vacation and to recuperate from injuries sustained when working on Sinclair Oil & Gas Company's No. 1, Cole, in East Texas.

Myron M. Kinley

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T. W. Herring, drilling superintendent for the Yount-Lee Oil Company, has moved from Beaumont to Marshall, Texas, so that he may keep in closer touch with his company's operations in the new East Texas oil fields.

PICTORIAL PETROLEUM

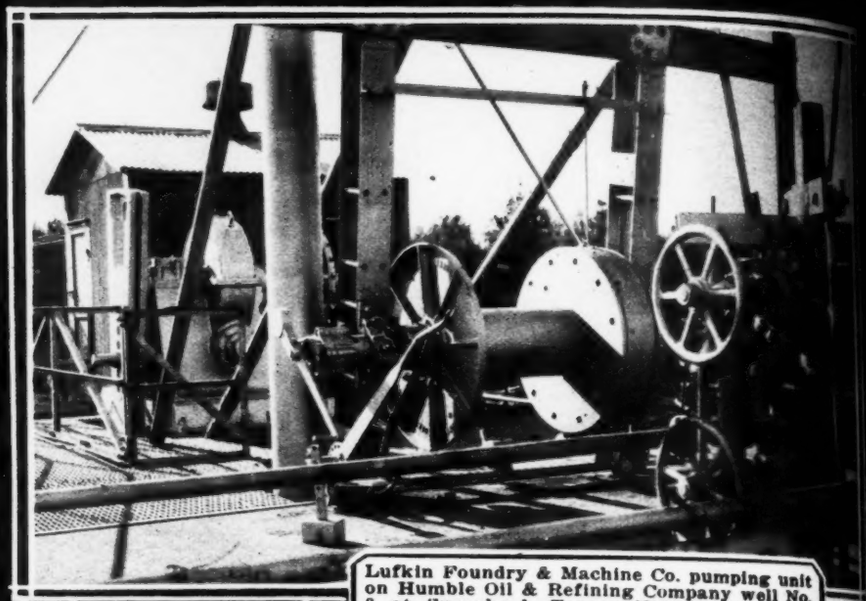
MONTHLY ROTOGRAVURE FEATURE OF

THE *Petroleum* Engineer

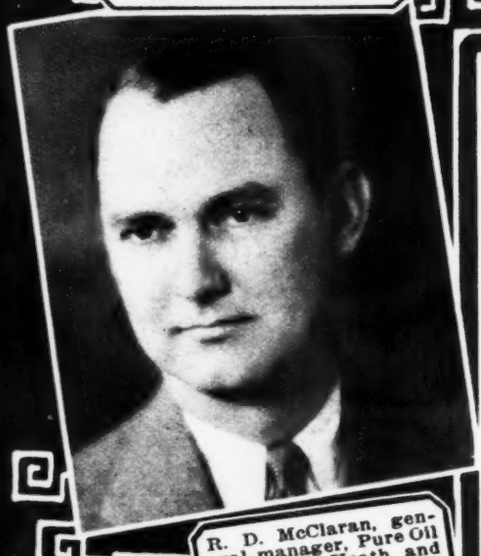
JULY 1931

Laying a natural gas pipe line across the San Gabriel River in Texas, a Lone Star Gas Company project.

Frederick D. Anderson, superintendent, California Division, The Ohio Oil Company, Los Angeles.

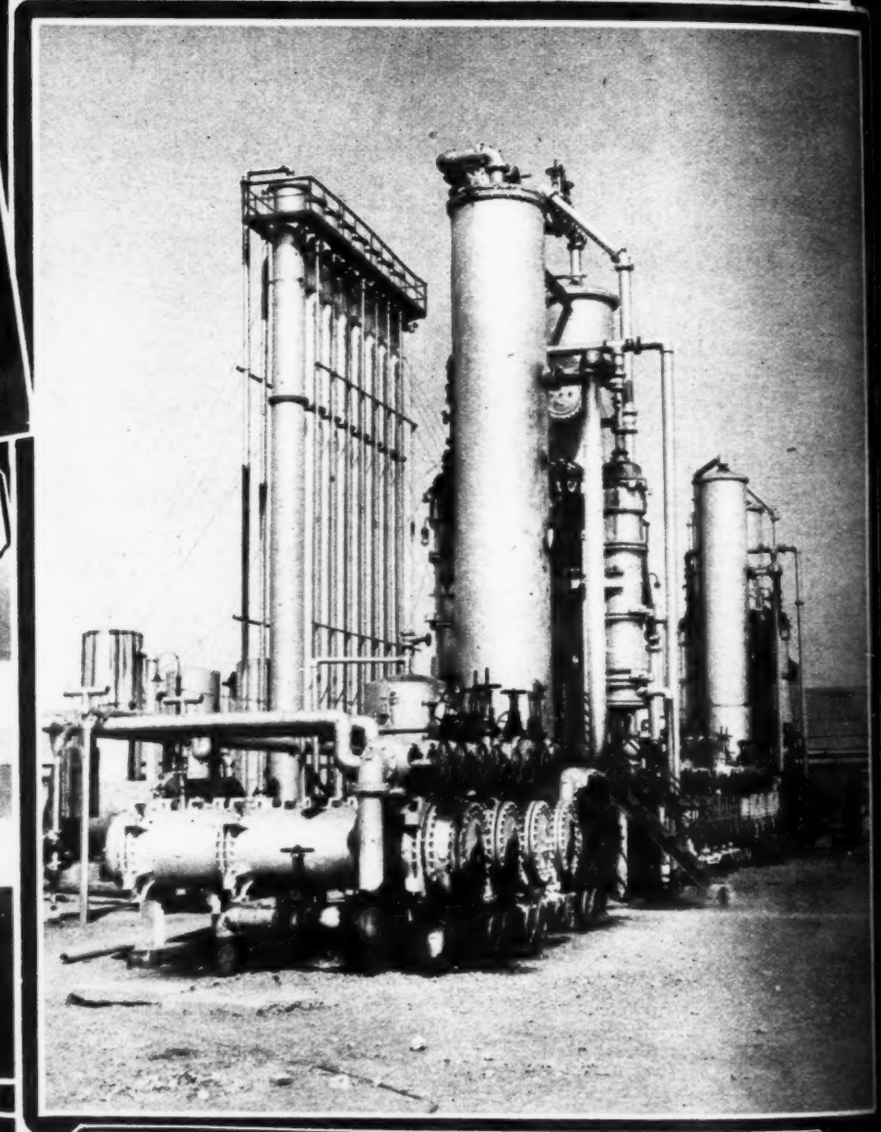


Lufkin Foundry & Machine Co. pumping unit on Humble Oil & Refining Company well No. 8 at Sugarland, Texas. Note the concrete derrick floor.



R. D. McClaran, general manager, Pure Oil Company's Heath and Toledo, Ohio, refineries.

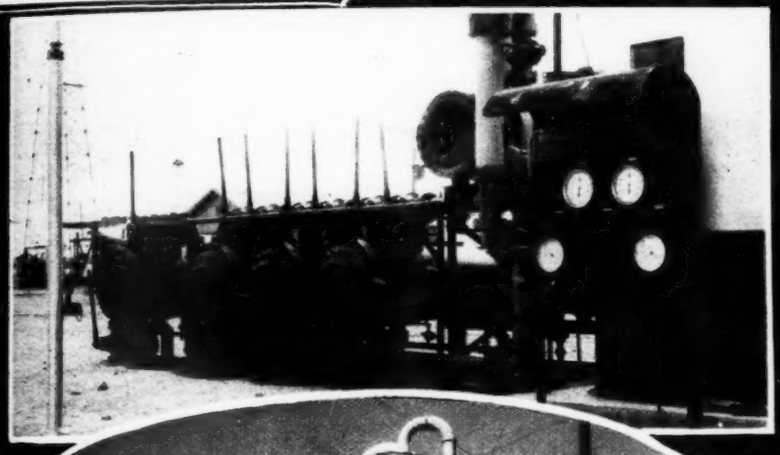
E. L. Chatfield, purchasing agent, Producers & Refiners Corp., Tulsa, Okla.



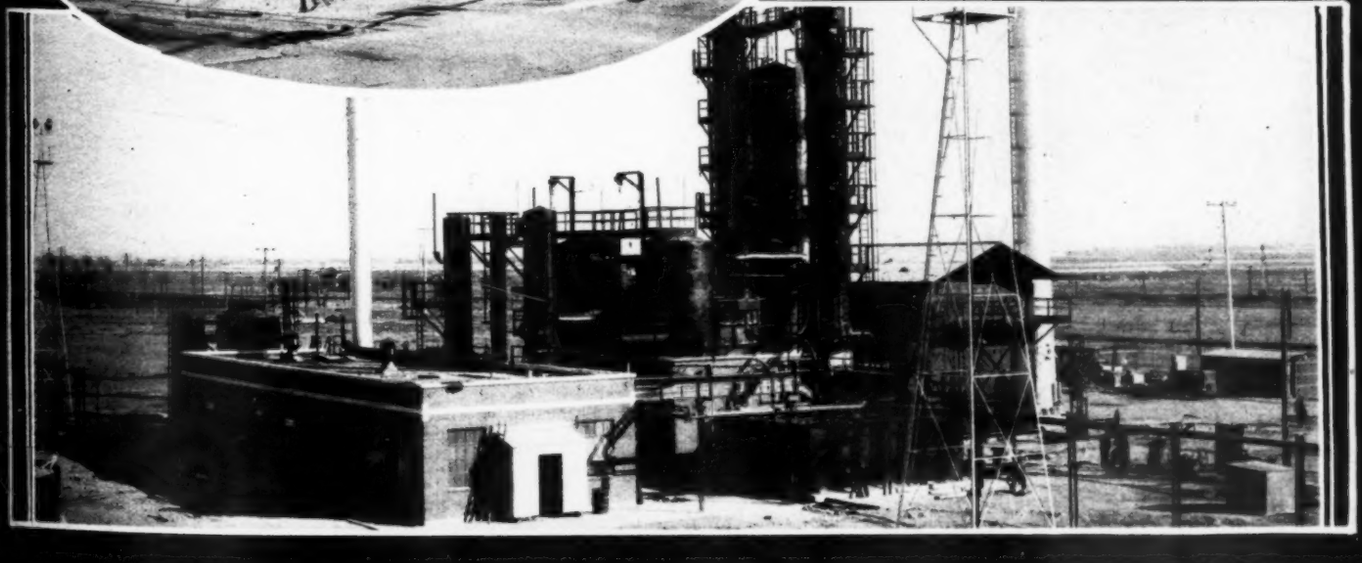
Casinghead plant of the International Petroleum Company, Negritos, Peru.

Ray E. Epperson of the Motor Transportation Division of The Empire Companies, Bartlesville, Oklahoma, and his two-place cabin monoplane.

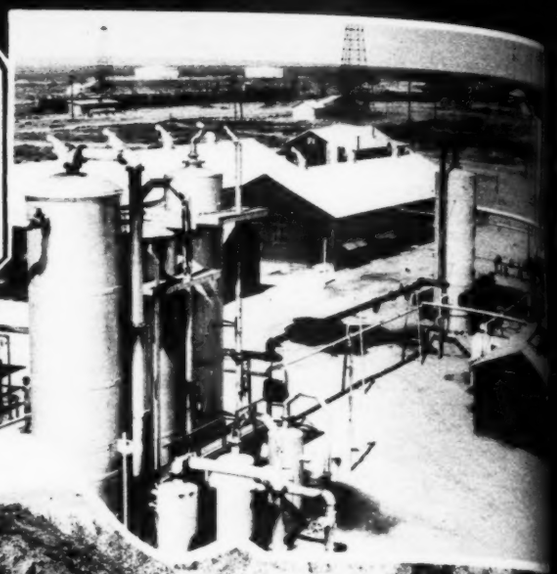
A. J. MacKinnon, superintendent gasoline department, United Carbon Company, Monroe, La.



Above—A. C. Jamison, district superintendent Arkansas Natural Gas Company, photographed in East Texas. Left—Office and warehouse of California Talc Company Inc. and Baroid Sales Company, Los Angeles, Calif. Above left—Heat exchangers at the Signal Gasoline Company's new plant at Rita Santa, Texas. Equipment manufactured by C. F. Braun & Co., Alhambra, Calif. Below—Distillation and cracking unit of Continental Oil Company's new Denver refinery.

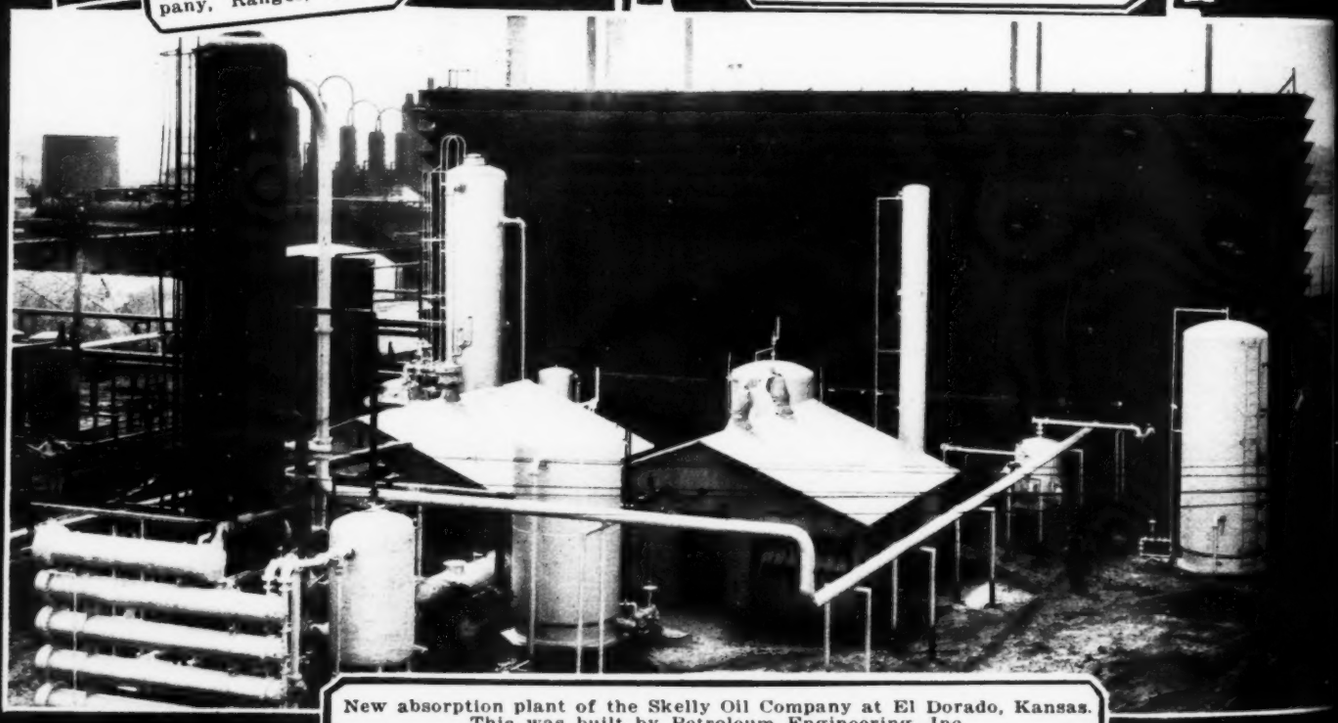


Left—R. A. Crawford, vice president and general manager of the Lone Star Gas Company, Dallas, Texas. Right — View of Signal Gasoline plant, Big Lake field, Texas, showing absorbers in the left foreground, heat exchangers and still on the right and loading rack in the background.



F. G. Yonker, general superintendent, Lone Star Gasoline Company, Ranger, Texas.

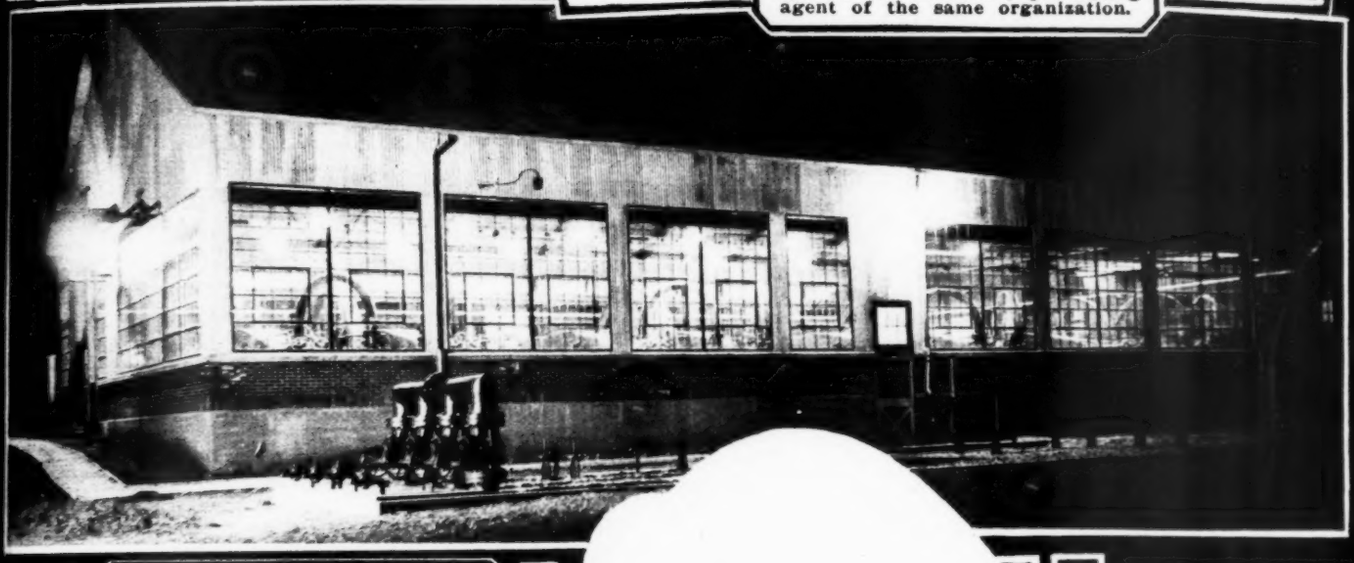
Byers excavator at work on Phillips gasoline line, which project was constructed by Kelly Dempsey & Co., Tulsa, Oklahoma.



New absorption plant of the Skelly Oil Company at El Dorado, Kansas. This was built by Petroleum Engineering, Inc.

Gas flare in the Big Lake, Texas, field.

Left—A. B. Irion, general superintendent, Southern Crude Oil Purchasing Co., Fort Worth, Texas, and right—R. D. Saunders, purchasing agent of the same organization.

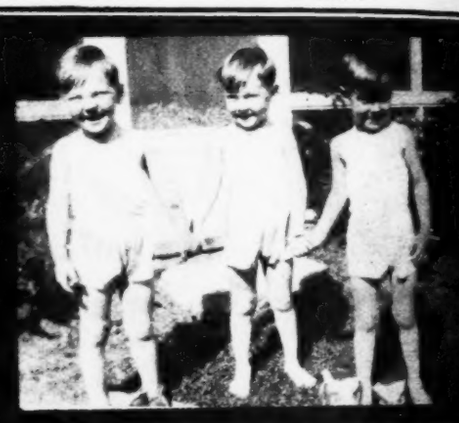


Above—Night view of Cities Service Gas Company's compressor station in Drumright, Oklahoma. Below—Caterpillar 30 negotiating a difficult strip of mud with a length of pipe weighing 4,000 lbs.

R. C. Alden, research engineer for Phillips Petroleum Corporation, Bartlesville, Okla.

An interesting action photograph showing Cardwell All-steel pipe line winches handling 24-inch pipe on a Continental Construction Co. line in Western Kansas. Contractors on the line were Bechtel & Kaiser.

Some of the shops at the Anglo-Persian Oil Company's research station at Sunbury-on-Thames, England.

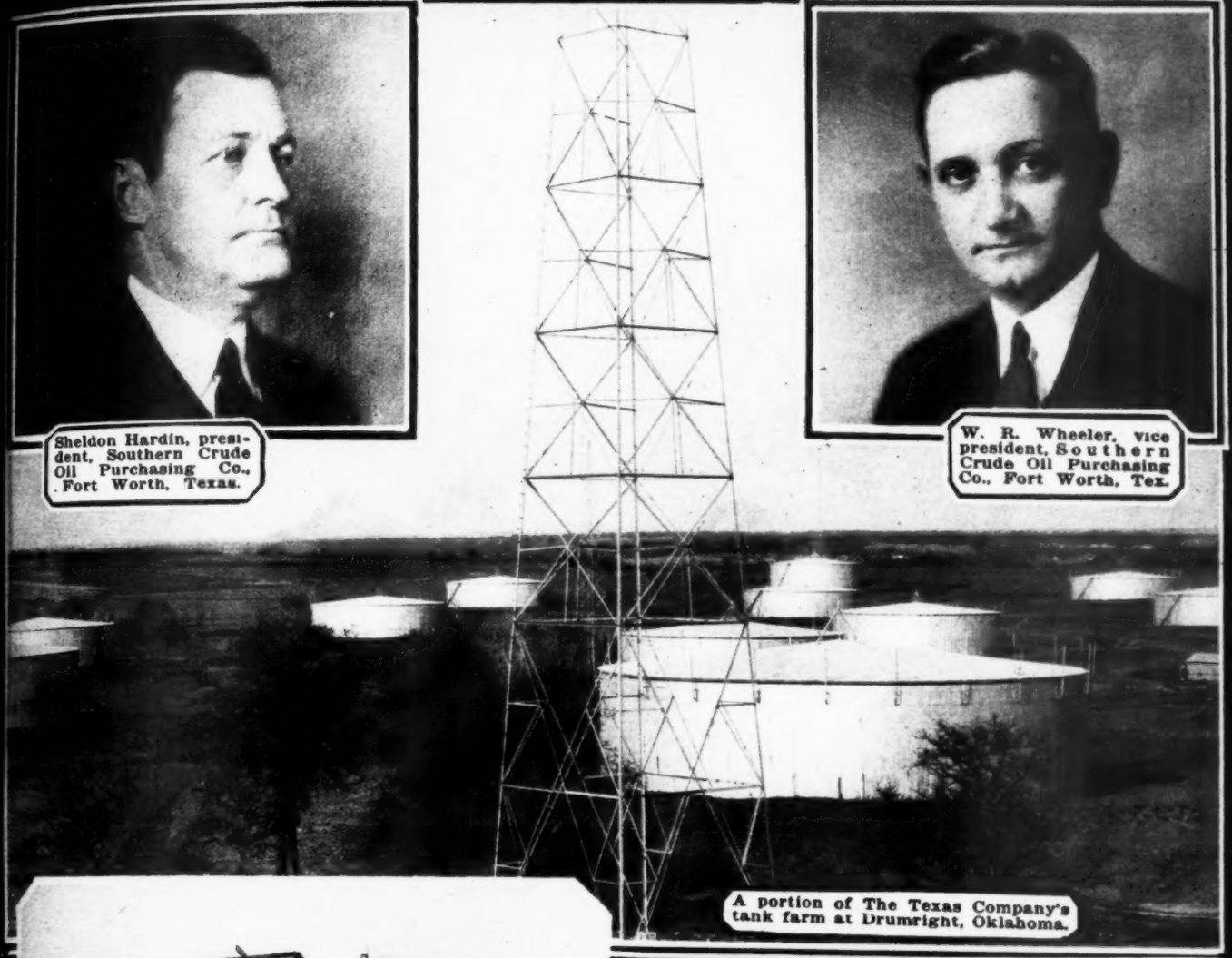


From left to right are "Doc", "Don" and "Chris", triplets of which Mr. and Mrs. D. C. Williams are justifiably proud. Mr. Williams is superintendent of the gas department of Continental Oil Company, Ponca City, Oklahoma.

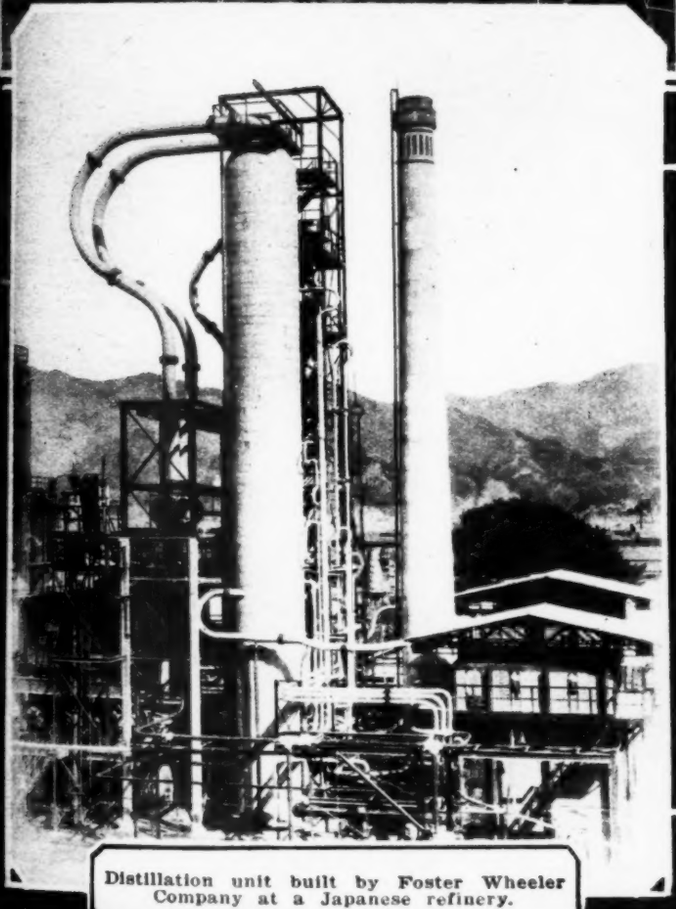
Photograph from the collection of Williams Brothers, Tulsa, Oklahoma, showing manner in which 22" pipe was transported down the Mississippi by barge for the Monroe-New Orleans gas line.

Sheldon Hardin, president, Southern Crude Oil Purchasing Co., Fort Worth, Texas.

W. R. Wheeler, vice president, Southern Crude Oil Purchasing Co., Fort Worth, Tex.



A portion of The Texas Company's tank farm at Drumright, Oklahoma.



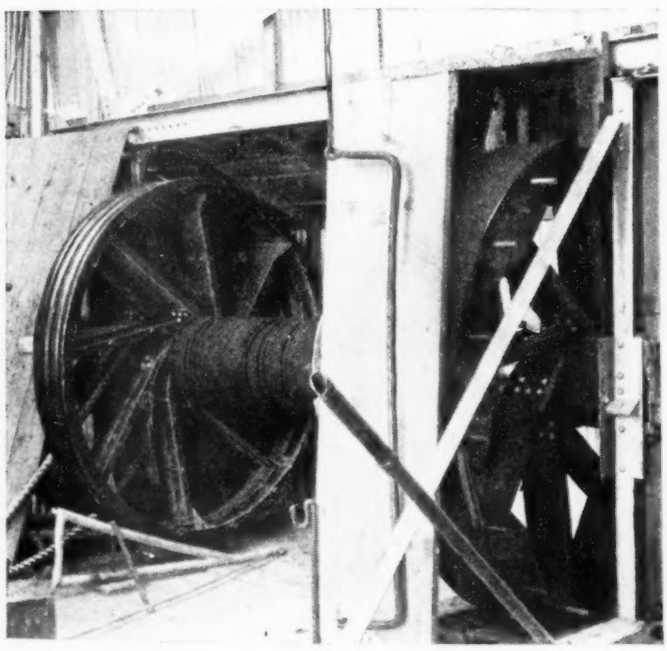
Distillation unit built by Foster Wheeler Company at a Japanese refinery.

Robert Wesley Brown, petroleum engineer, Producers & Refiners Corp., Tulsa, Okla.

H. L. Hickman, (left) district foreman, and L. E. Cozzens safety engineer, both with Oklahoma Pipe Line Company, Muskogee, Oklahoma.

Battery of tanks having Wiesing flotation roofs, mounted at Pavilion, New Zealand, and owned by Taranaki Petroleum Refineries Limited.

IT'S A LONG LONG JOURNEY TO THE SCRAP HEAP FOR MOORE STEEL WHEELS . .



A heavy duty Moore Bull Wheel with double brake wheel and triple tug wheel. The shaft is 18" in diameter, with 1½" wall. Other models, differing from this to meet requirements, are available. The shaft is heated and shrunk over the gudgeons. The latter are riveted in place. Spokes are tangent to the shaft and exert a direct push on it. The tug rim is of one-piece rolled steel. A. P. I. dimensional standards.

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Methods and Equipment used in Liquid Level Control

P. A. ELFERS[1]

THE control of liquid levels has become an important part in the operation of refineries and gasoline plants —in fact, in all divisions of the oil industry.

Not many years have passed by since the introduction of level control, particularly of the float cage type, for the maintenance of level in pressure tanks. This type of controller came into active use in the oil industry about the time of the Ranger (Texas) boom in 1917. Previous to that time, level controls had been used in industrial application for the maintenance of level in feed water heaters and the height of liquids in open tanks, by means such as lever valves with a float at the end of the lever, similar to illustration, Fig. 1. The cage type units for feed water heaters and the open tank controls were not generally applicable for the service as required in the oil and gas industry, but with variations and improvements the first edition of what was known to the operators as "kidney valves" was introduced. This original development was quickly adapted to the oil and gas separators, which appeared in the industry at that time.

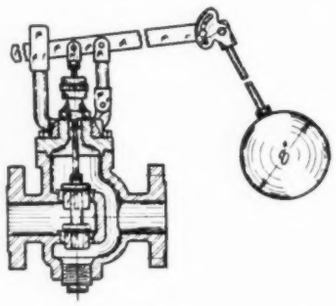

Fig. 1.

As the operators of ten years ago will well remember, the controller was built as Fig. 2, the kidney consisting of two split halves which were bolted by seemingly innumerable bolts around the outside of the cage. The operation of these units was inherently the same as the float cage control of today, in that a ball float inside of the "kidney" followed the liquid level, its movement translated outside through a stuffing box, the power thus developed operating a balanced lever valve. The refinements of today were missing, the floats were not as rugged, and the pressure ranges of the controls were limited. Also, after a unit was taken apart, extreme difficulty was experienced in always getting the bolts of the split halves evenly taken up and the "kidney" tight. At first three structures were available—a low-pressure "kidney" for a maximum of 50 pounds pressure, a medium-pressure cast semi-steel unit for 125 pounds, and a cast steel cage for 250 pounds. Many of these units are still in service throughout the oil fields.

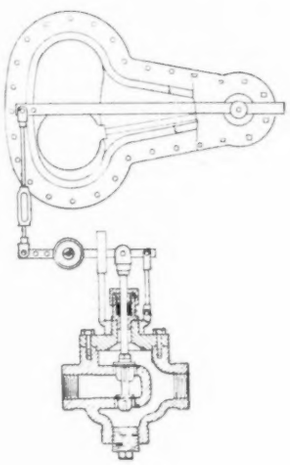

Fig. 2.

The use of liquid level control broadened widely, until its service extended to the control of levels in oil and gas separators, accumulators, in gasoline compression plants, run-down tanks, drips in lines, absorption towers, rich oil stills, scrubbers, condensers, dephlegmators, separation of immiscible liquids, stabilizers, stills, cracking chambers, etc.

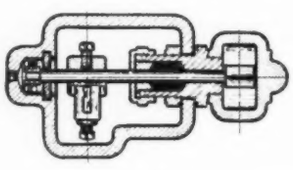

Fig. 3.

Pressures and services continually expanded and the split bolted "kidney" cage was unable to meet all the services due to limitations; principally in inability to meet the increasing pressure trends. After some tests and development work the present form of liquid level controller, with the bolted arm design, was introduced in 1923. Its advantages were that it could withstand high working pressures, and was exceedingly rugged in design to withstand the hard service that controls are subjected to in the field. A control of this design is shown in Fig. 4.

The operation of the level control does not always mean the operation of a valve structure controlling the flow of liquid to and from a tank or similar receptacle, but at times controls the steam supply to a pump, controlling the speed and as a result, the amount of fluid that the pump handles. This results in the supplying of another part of a system with fluid at the same rate at which it is received in the storage tank, or discharged from the previous processes. The float might also by-pass an electrical driven pump unit, start and stop motors, light indicating lamps, and numerous other performances.

As process pressures became higher and closer level controls were a necessity, friction entered severely into the reaction of the controls. An analysis indicated friction due to several causes. One of these was due to the end thrust of the stem of the float cage, with resultant rubbing of float rod on the body of the casting. Unless a rotary stem is held in position by an outside means, a force on the end of the stem will cause the stem to slide or slip through packing until some obstruction prevents its further movement. In the first level control units, the force due to pressure on the stem area forced the stem outward until the float rod connecting float and rotary stem began binding on the arm of the cage. To take up this end thrust and insure free movement, a yoke ball-bearing was added to the stuffing box in 1926. This bearing not only absorbed the thrust and prevented side movement, but also acted as a radial ball-bearing, eliminating side-play or wobbling in the rotary stem. Fig. 3 shows a typical structure developed at that time for the elimination of the above friction.

That the use of a thrust bearing on a

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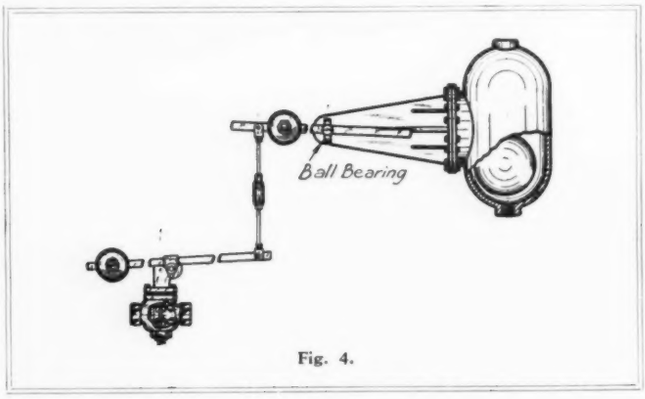

Fig. 4.

rotary stem was advantageous was soon seen and all manufacturers adopted this construction. Its appearance and usefulness also extends to the rotary bonnet valve structure, Fig. 4. A recent development, Fig. 5, in a stuffing box has condensed this outboard bearing structure, keeping all the advantages and allowing forged stainless steel construction.

A stuffing box providing an absolute seal when a controller was functioning under vacuum conditions was needed. Infiltration of air might mean an explosive mixture, spoiling a product or reduction of vacuum, thus the oil or water seal stuffing box became a standard for these conditions. This stuffing box contains a "lantern seal ring" to which a supply of oil or water (this liquid should be the same as in the tower) is supplied causing the shaft to be liquid sealed. Any leakage of air is prevented and the small leakage of fluid into the system is immaterial, not only because it is supplied from a reservoir, but since it is the same base or product as in the tower.

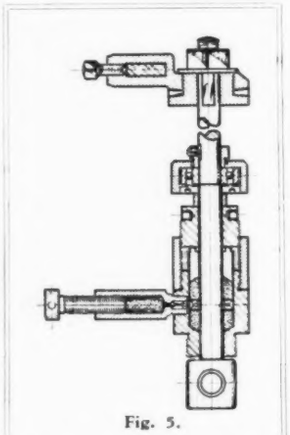

Fig. 5.

Again pressures and temperatures made further demands, and reduction of leakage past packing became of importance. Under certain conditions the use of a lubricant, which is insoluble in the fluid being handled, is highly effective in keeping down this leakage and preventing a hardening of packing. Level controllers are now available with stuffing boxes having a lubrication connection, this entirely at the option of the user. Another trend was the reduction of diameters of stems, thus reducing packing friction to its possible minimum.

Floats have become stronger and better suited to the conditions of operation as progress has been made by the manufacture of these articles. In the first level controls it was common to furnish a copper float for practically every service. Logging of floats was a common occurrence and a decided nuisance. Corrosive gases and liquids took rapid toll of these floats, and the first step to prevent this action was the plating of copper with nickel, chromium, or cadmium. At the same time, a float made of copper to withstand high pressures was extremely heavy and the next step was to obtain a spun aluminum float for light fractions. While aluminum is resistant to hydrogen sulphide, traces of caustic are reactive with it, and necessitated plating by metals above mentioned. For very high pressures, above 500 pounds, and high temperatures, welded steel floats entered the field about four years ago with exceedingly good results. With the advent of stainless steel, and satisfactory spinning and welding of it, this material is used today and is furnished by manufacturers at no additional cost over aluminum floats or plain steel, and at a cost lower today than the inferior floats of five years ago. Stainless steel floats, as above mentioned, are furnished by manufacturers either in the well-known chromium 12 per cent-14 per cent, or KA2—chromium 18 per cent, nickel 8 per cent. The improvement in quality and service of floats is a reflection to the float manufacturers and their experimental work over the last ten years.

The material used in the cages of the liquid level controllers themselves has undergone many changes. Previously controllers were only furnished in cast iron construction with a maximum pressure of 300 pounds and 400 degrees F. temperature. The next step was to cast steel for use up to 600 pounds pressure and 750 degrees temperature. Today the engineer is able to obtain float cages in chrome-steel castings for pressures up to 900 pounds and 900 degrees F. temperature. In the same way, the battle against corrosion has been constantly waged onward and most manufacturers today furnish their level controllers fitted with stainless steel at all points where wear, corrosion, or contact with corrosive gases takes place. Compare these present day units to the controls of yesteryear when bronze and copper were the average trimming.

In the foregoing we have discussed materials and structural changes made to meet and offer the industry better control and liquid level. Operators can recall that not so many years ago level control was practically entirely obtained by use of the lever valve, the movement of the float in the "kidney" moving a lever on the cage, which motion was transferred to a lever valve such as in Fig. 4. Limitations were inherent to this structure in that it required either that the control valve be placed directly above or below the "kidney," or the highly unsatisfactory "pulley arrangement" be used. The placing of the valve under the "kidney" meant excess piping, which entailed additional expenses, complicated line arrangements, and a loss in power due to frictional resistance in the additional footage. Pulley hook-ups are difficult to keep in order; the flexible wire gathering slack; the pulleys creating friction points; the wire in the road of the operators; a loss in neatness around the plant, and yet, what was the designer to do on a unit where the level of the oil in an accumulator or tank was to control the speed of the pump, removing this oil either to another tank or to charge it into a process cycle. He could not very easily move the pump under the "kidney" float cage. Or on the controller at the bottom of a stabilizer, it would require that the line from the heat exchangers would have to be brought back around and under the "kidney" float cage for the valve position. These objections were by no means the most serious. It was only possible to develop a given amount of power with a buoyant float.

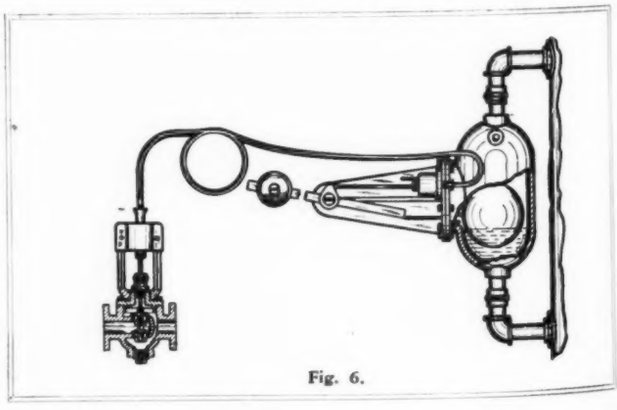

Fig. 6.

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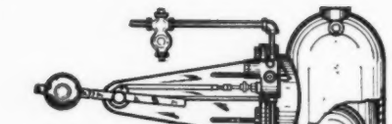

Fig. 7.

this in direct relation to its size and weight. Balancing with counter-weights to obtain maximum buoyancy was also practiced but the additional weight, when it becomes overly heavy, creates a tendency for the float cage stem, which comes through the stuffing box to bear against the side of the stuffing box. A large weight also creates inertia; that is, desire to remain at rest in a given position. As the pressure of the "kidney" float cage increased, packing offered more friction and with lighter liquids the power available rapidly decreased. To illustrate this point, let us assume an 8-inch float ball in service in 90 Be' A. P. A. gasoline at low pressure, for example 30 pounds and atmospheric temperature of 80 degrees F.

	A		B	
Liquid	90 Be' A. P. I.		145.7	
Temperature	80 degrees F.		60	
Sp. Gr. at 80 degrees F.	0.6388		.51	
Maximum displacement upon total submergence, 8-inch ball float.	268.08	cu. in.	268.08	cu. in.
Maximum buoyancy or power available at half submergence — displacement	134.+	cu. in.	134.+	cu. in.
Assumed at rest with liquid on center of float due to proper counter-weighting on the outside.				
Displacement of liquid due to 1-inch rise in level without movement of float	49.21	cu. in.	49.21	cu. in.
Weight of liquid displaced, 80 degrees F.	1.1349		.9061	
Lever arm	25	inches		
Power available outside of float at point 12 inches from float cage stem — assuming no frictional loss	2.364	lbs.	1.888	lbs.

Due to a slight difference in port diameters, there is a small unbalanced area in a balanced control or motor valve. As the valve size increases this difference in area becomes larger and, with higher pressures, a rapidly increasing amount of force is required to operate and close the valve. A hydraulic force due to fluid velocities is also present within the valve structure and as pressure drop across the valve ports becomes higher, the velocities become greater, with resultant increasing of these forces. Thus as valves become larger in size, or pressure drops become greater, increasing power is demanded.

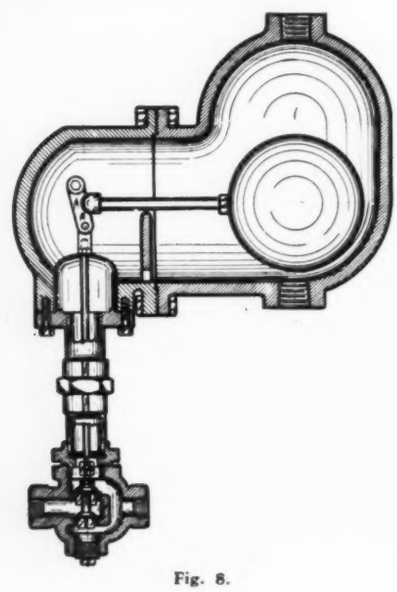

Fig. 8.

The limitations of placement were met by a remote type of control such as Fig. 6, of a type that the movement of the float was transmitted to a bellows at one end of a closed system, which was filled with a nonfreezable liquid with a negligible coefficient of expansion. At the other end of this system was a like bellows, the two connected by armoured flexible tubing. This latter bellows was connected directly to and operated a control valve. An expansion or compression of the bellows on the "kidney" float cage would cause a reverse action of the bellows at the valve with its resultant movement in position. Remote control with the valve, at a different position relative to that of the float cage was obtained, and no operating medium was needed, but the power developed was not increased which did not overcome the second limitations and limited its use to small valve structures.

For some installations it was desirable to multiply the liquid displacement power of the float many times in order to have ample power for the operation of the valve mechanism. By using a pilot valve and the pressure of an operating medium, this problem is solved. The movement of the float was transmitted to a small pilot valve on the float cage, Fig. 7, which in turn changes the pressure of the operating fluid on the diaphragm of a diaphragm motor valve structure. The power required to operate the pilot is exceedingly small, due to small ports, inner valve mechanism, and moving parts. The power available to operate the motor valve

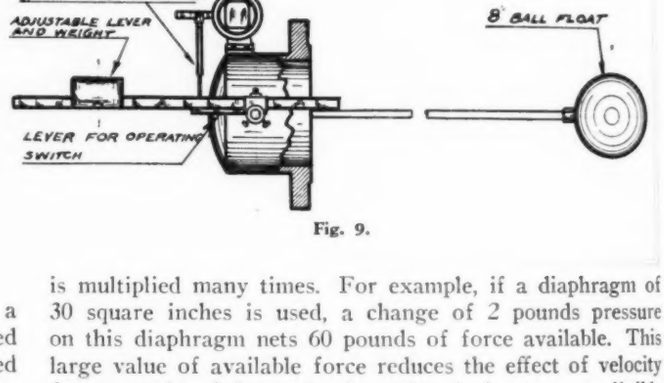

Fig. 9.

is multiplied many times. For example, if a diaphragm of 30 square inches is used, a change of 2 pounds pressure on this diaphragm nets 60 pounds of force available. This large value of available force reduces the effect of velocity forces, and unbalance in the valve body, to a negligible amount, and requires that the valve assume a position as directed by the position of the float. By the use of the pilot we now reduce the power required to a minimum, and if, for example, this were but one-tenth of the former requirements, the change in submergence would be decreased to a corresponding value, disregarding the friction of the stem which would remain fixed. As a result the float will closely follow the level of the liquid as it moves and better control will result, since the mechanical or power lag has become small.

This type of construction is offered by all manufacturers of level controllers, most types using air or gas as the medium to operate the control valve, though types are obtainable which permit the use of water or oil as this medium.

When liquid level control was first adopted, its primary purpose was to maintain the height of the level in the tank or reservoir and the action of the controller, whether throttling or quick-acting, did not enter into the picture as long as the level was maintained. An example of this would be filling of an open tank for cooling tower service, with the supply from some outside source. It is immaterial

whether the valve supplies the liquid by intermittent flow or not, as long as the level is maintained in the reservoir.

This control can be actuated by a structure that will cause a wide open position and then a closed position of the inner valve of the controller, or in other terms, a snap action unit. In another type of installation, as in a stabilizer control, the level controller permits the removal of the product or bottoms. This product carries B. t. u.'s and in order to effect a heat balance it is passed through heat exchangers and transfers its heat to the incoming gasoline, at the same time being cooled previous to storage. The flow of incoming product is controlled at a constant rate, thus effecting efficient and uniform heat exchange, the outlet flow must be uniform. An open and shut action of the controller valve is absolutely out of the question. Due to variation of the incoming raw gasoline, and variation in feed as changed by the operator to fit the operation required, the amount of discharge through the liquid level controller will vary slightly. The control operation must perform so that a small change in the level will change the position of the controller motor valve only an increment, and change the rate of flow by only the same value as indicated by the level rise. This demand on the controller means that perfect throttling or floating action must be obtained, and the controller should respond to the slightest change in level. Here the advantageous use of small stems, pilot control, and ball bearings are clearly seen. The floating action of the controller means a rather long valve travel to obtain full opening of the motor valve, and to obtain this full travel a total level variation of 8 inches may be needed. The normal operating changes do not call for a large change in valve position, and during operation the level may never be called upon to change more than 1 inch, ½ inch from normal level position either way. The important feature, however, is obtained, that is, floating gradual opening of the motor valve or gradual change of flow. Level controllers are so constructed that the operator can obtain full throttling action or snap action upon adjustment, thus enabling him to adopt the controller to his particular need and conditions.

The cost of operation of a remote or pilot level control is normally overlooked. Two types of controllers are available to the operator; one type having a constant leak and the other type leaking or discharging gas or air only when the level controller and level has reacted to require the motor valve to open. Where this little type remains at rest for long periods, either not being required to work due to low level, or else at rest in a floating position due to constant conditions on the system, a leak is not required, eliminating operating cost. If the controller is of the constant leak type, having a leak of 100 cubic feet per hour, which will be 2,400 cubic feet per day, the cost of the operation can readily be obtained on the basis of the operator's compression cost per 1,000 cubic feet of air.

Special operating problems have been met by varied designs, as for example, a control to remove immiscible liquids from petroleum fractions, as the separation of water and crude oil. This is accomplished by weighting the float, so that it will sink in the lighter constituent and float in the heavier. The heavier is drawn off, as it accumulates, through a balanced valve actuated by one of the means previously discussed.

Controlling the level of crudes, such as encountered in Texas Panhandle, where solidification took place when the oil was lowered to atmospheric temperature, brought the development of the steam-jacketed float cage in order to keep the oil which was at rest in the float cage in fluid form.

On accumulators in compression plants, where small quantities of gasoline at high pressures are to be handled, and where the common known lever type of controller presents limitations due to friction and packing leakage, and where it was not economically advisable to use a pilot control, a compact level control of a type as shown in Fig. 8 met this condition with success. The self-contained feature, with lack of stuffing boxes, overcoming the limitations as noted.

As the refining industry processes oils further, and the bottoms become more viscous, the tendency of the fluid to cool and congeal in the float cage became more pronounced. Larger and heavier stuffing boxes than could be placed on the float cage were required. The inside float controller, Fig. 9, was devised to meet and overcome the objections of the "kidney" type, with the motor valve controller either by level or pilot valve.

As problems in the control of liquid levels arise, manufacturers are continually developing new refinements for the most efficient control required by the refiners, natural gasoline manufacturers, and producers. The last seventeen years of level control have herein briefly been reviewed.

Modern Stations Emphasize Service

FOLLOWING on the heels of the announcement by the Cities Service Gas Co. of a "million dollar" compressor station at Blackwell, Okla., came the news of a similar project at Drumright, Okla. Both stations were designed by the Cities Service Gas Company and were completed in a remarkably short time. Approximately 175 men were employed in constructing the plant at Blackwell.

Of particular significance to the gas industry is the emphasis placed on service to gas company customers. Seemingly no modern facility is lacking. The buildings were exceptionally well planned and erected — at a minimum of expense, however, for that class of work. Frills and useless material were omitted.

Cooper-Bessemer compressor units at Drumright take gas from the field lines and deliver it into the Cities Service Gas Company's main transmission system. Equally large compressor units at Blackwell handle gas from the field, including the Oklahoma City field, sending it into the main line of the company. Main trunk lines transport the gas to many cities and towns in Oklahoma, Texas, Kansas, Missouri and Nebraska.

Drumright station has four, Blackwell has five 1,000-h.p. Type 22, twin-tandem, double-acting gas engine compressor units. Auxiliary power for each main plant is provided by two 190-h.p. gas engines which drive 120-kw., 150 K. V. A., three-phase, 60-cycle A. C. generators.

The current generated goes to electric motors which drive cooling water pumps and starting air compressors. Current also furnishes lighting for main and auxiliary buildings, the office and community club building, the superintendent's cottage and other dwellings.

Two 190-B. H. P. Cooper-Bessemer gas engines at the new Blackwell, Okla., station of the Cities Service Gas Co.

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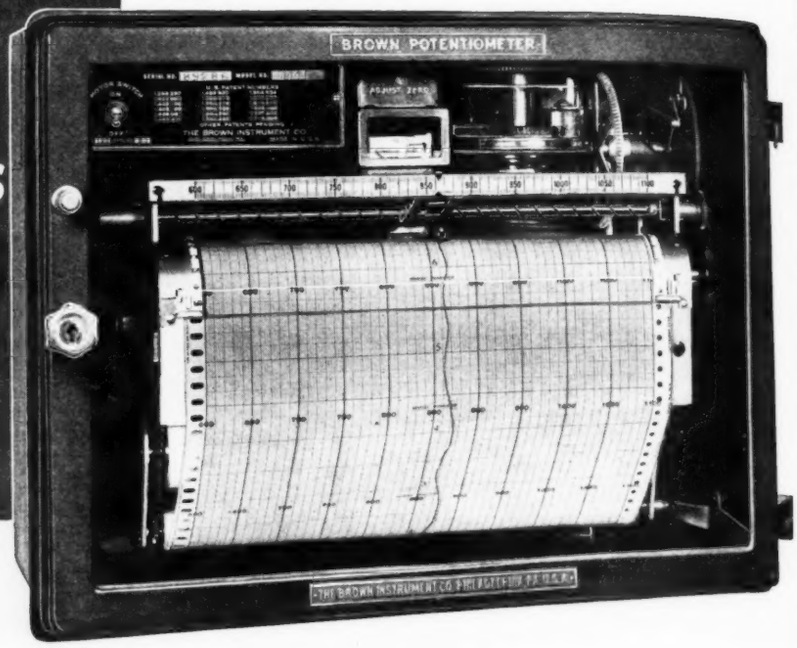

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By EDWARD E. DILLMAN*

WELDING of Field Storage Tanks without limitation as to size, and without the use of bolts for fitting together the plates making up the shell of these tanks, is an accomplishment of the Wyatt Metal & Boiler Works. In offering welded tanks to the petroleum industry, in which the tightness and efficiency of the welded joint is made available, the above company believes that a real service has been rendered to the users of this class of equipment.

In the past few months the Wyatt Metal & Boiler Works has successfully completed a total of fifty-eight tanks aggregating 340,000 barrels and has under course of construction 330,000 barrels of additional storage that includes 55,000 and 80,000 barrel tanks.

The fitting up of these tanks by the use of wedge pins and clips is covered by a patent which is now pending. By means of these clips the plates are firmly held in position and at the same time the seams are properly gauged. The type of joint used is either a lap joint or a butt strap joint, the welding specifications and the type and design of joint depending upon the efficiency required of the joint and the thickness of the shell plates.

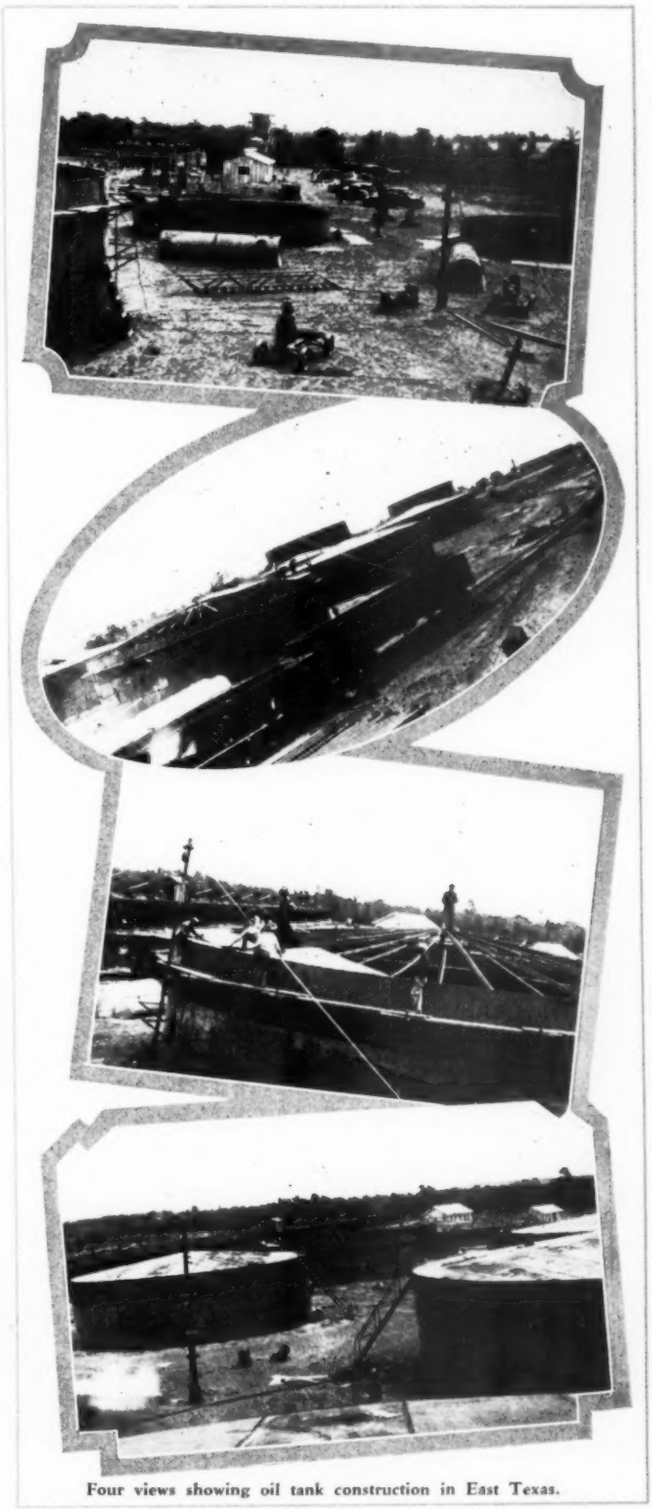
Lower cost per barrel storage is obtained through the greater efficiency of the welded joint and the fact that lower shop and field erection costs are possible. To the person familiar with tank construction and design, it is a known fact that a tight, leak-proof, and safe tank can be secured in which plates are used that are appreciably thinner than the minimum required in most tanks. This is because an ordinary tank seam must be caulked and it is impractical to use plates thinner than three-sixteenths-inch. This thickness of plate must, therefore, be specified, although the joint efficiency from the standpoint of strength alone would require a thinner plate.

The purchaser of a welded tank purchases economies that go beyond the saving in first cost.

The pioneer in every field has been faced with problems and resistance to his endeavors. It has not been found any different by the Wyatt Metal & Boiler Works in the completion of successful welded tanks. Things learned in the building of riveted tanks had to be altered, and it is more difficult to do this after a custom has been well learned than to teach one in the beginning. A new problem was encountered in welding tanks, and these problems had to be met in entirely different ways than those used with riveted tanks.

The handling of the steel and the raising of the steel into position for clipping into place presented unusual problems. To the outsider, who sees only the completed job, the work is simple and fast. But to the people who started from the beginning without knowledge gained from former work it was touch and go from the laying of the first sheet to the welding of the last fitting.

The welding procedure as used on the bottom had to be carefully worked out. Steel as it is welded together will creep, expand and contract. The bottom angle was expected to change in diameter after it was welded, and the shell plates had to be so welded and fitted up that as this change in diameter came about so that the plates would be free to fit this new diameter. These problems were foreseen and met with promptness and knowledge gained through a varied experience in the working of steel plates. The thought must needs be in mind that the method of construction is new and must be met not with the old ideas and methods, but with new design, equipment and careful control of the welding procedure.

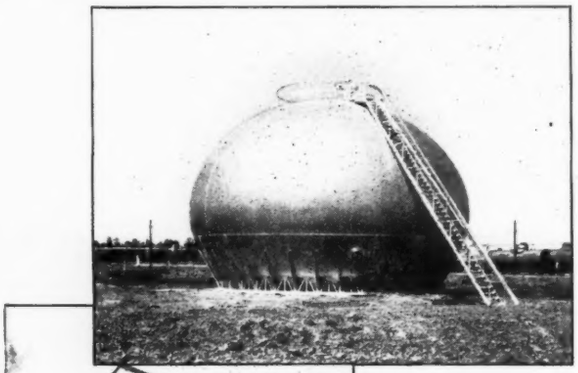


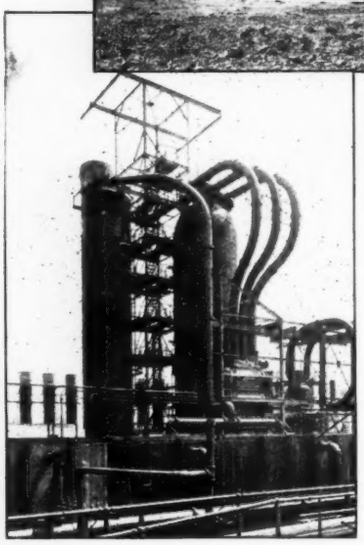
Four views showing oil tank construction in East Texas.

*Sales Engineer, Wyatt Metal & Boiler Works.

HORTON PRODUCTS

for all Oil Storage *and* Plate Work Needs





(Above) A Hortonspheroid for pressure storage of volatile products. (Left) Typical installation of Horton refinery plate work.

THE wide range of Horton products embraces practically every oil industry requirement for tanks, plate work, special tank roofs and pressure storage containers.

Producers, refiners, marketers and pipe line companies everywhere prefer Horton tanks and plate work for these reasons: Their design and construction are the result of long experience in oil field problems . . . they are backed by a consistent record of satisfied users . . . four modern fabricating plants assure time and money saving delivery . . . our own experienced erection crews are available anywhere.

We appreciate the opportunity of furnishing information and quotations on all of your tank and plate work requirements. Please address our nearest office.

Chicago Bridge & Iron Works

Chicago	2481 Old Colony Bldg.
New York	3173 Hudson Terminal Bldg.
Cleveland	2251 Midland Bank Bldg.
Dallas	3371 Magnolia Bldg.
Birmingham	1570 Fiftieth Street North
Tulsa	2434 Exchange Bank Bldg.
Houston	1137 Electric Bldg.
Detroit	1538 LaFayette Bldg.
Philadelphia	2635 "1616" Walnut St. Bldg.
Boston	1535 Consolidated Gas Bldg.
San Francisco	1064 Rialto Bldg.
Seattle	4345 Smith Tower
Los Angeles	1346 Pacific Mutual Bldg.

Oil Storage Tanks . . Wiggins Roofs . . Hortonspheroids . . Hortonspheres . . Cylindrical Tanks . . Elevated Tanks . . Agitators . . Bubble Towers . . Condenser Boxes . . Refinery Platework . . Smokestacks . . Gas Holders . .

PE7-15 Gray

When writing CHICAGO BRIDGE & IRON WORKS, *please mention The Petroleum*

A NEW CATALOG of the looseleaf file type has been prepared by the Gulf Coast Machine & Supply Co. of Beaumont and Houston, Texas. The catalog describes drilling equipment, production equipment, high pressure equipment and pipe line equipment.

PACIFIC OIL TOOL CO., Ltd., Los Angeles, Calif., has issued a booklet on casing and tubing packers. The booklet describes the company's multiple ring packers of the various types.

A CARBON DIOXIDE MEASURING INSTRUMENT for use in measuring the percentage of carbon dioxide present in flue gases is described in The Brown Instrument of Philadelphia, Pa., new catalog, entitled Brown Electric CO2 Meters, indicating and recording, Catalog No. 3004.

HILLS-McCANNA PROPORTIONING PUMPS for feeding treating agents into crude oil charging stock, boiler-water, etc., is the topic in a pamphlet being distributed by the Hills-McCanna Co. of Chicago, Ill.

COFFING HOIST COMPANY, Danville, Ill., has issued a small catalog describing the company's various model hoist and their application in the oil fields.

AMPCO NON-SPARKING TOOLS are described in a new catalog being issued by Ampco Metals, Milwaukee, Wis. The use of these tools to assure the maximum safety from dangerous fire hazards in the oil industry is told in the information contained in the catalog.

THE BOOK OF PIPE PROTECTION, including the mechanical application and coating and wrapping at the pipe mill, specifications and price list, is available from the General Paint Corporation, Hill, Hubbell & Company Division, of San Francisco, Calif.

THE SPENCE LINE OF EQUIPMENT is described and illustrated in a new catalog just off the press. This may be secured from the Spencer Engineering Company, Inc., pressure regulator manufacturers, New York, N. Y.

THE MAKING OF SODA SOAP GREASE is the subject of an article published in circular form by Sowers Manufacturing Co., Buffalo, N. Y. This is the fourth discussion circular on heating, cooling and mixing.

DETRICK REFRACTORY ARCHES AND WALLS FOR FURNACES is a handbook for designers and users of sectionally suspended refractory arches and walls. It is available from the M. H. Detrick Company, Chicago.

A NEW DIESEL ENGINE FOLDER issued by The Cooper-Bessemer Corporation, Mt. Vernon, Ohio, contains illustrations and specifications of the new stationary type JT Diesel engine. The rated horsepowers of this engine are 150-180; 200-240; 300-360; 400-490 when operating within the speed range of 300-360 r. p. m. with castiron pistons.

THREE NEW BOOKLETS have been distributed by the Republic Steel Corporation. "Sheet Iron—a Primer," is a 64-page illustrated booklet telling in non-technical language the story of iron-working and describing, step by step, modern commercial practice of sheet rolling. This booklet is now in classroom use in more than 1,200 schools and universities in this country and Canada.

"Toncan Iron Pipe for Permanence" is likewise a 64-page booklet illustrating many interesting installations and applications of Copper Molybdenum Iron Alloy Pipe. Several typical examples of service under unusually severe conditions are also given.

"Agathon Alloy Steels" is an illustrated handbook of 132 pages giving recent and authoritative data on alloy steels. Complete instructions for heat treatment of these steels is given in convenient chart form.

A FOUR-PAGE FOLDER handsomely printed in blue, silver and black is being distributed by The Brown Instrument Company, Philadelphia, describing the new Brown Potentiometer Pyrometer. The folder is well illustrated, showing nine of the fifty novel features claimed for this new instrument. An excellent view of the complete instrument is shown on the first page of the folder. Copies of this folder may be obtained by applying to The Brown Instrument Company, Philadelphia, Pa.

"SPECIAL PROCESS EQUIPMENT" is the title of a new bulletin issued by The Babcock & Wilcox Company.

This publication describes the fabrication of riveted and welded pressure vessels, tubular equipment, penstock piping, bends and forging. All these products are illustrated by photographs and descriptions of typical installations.

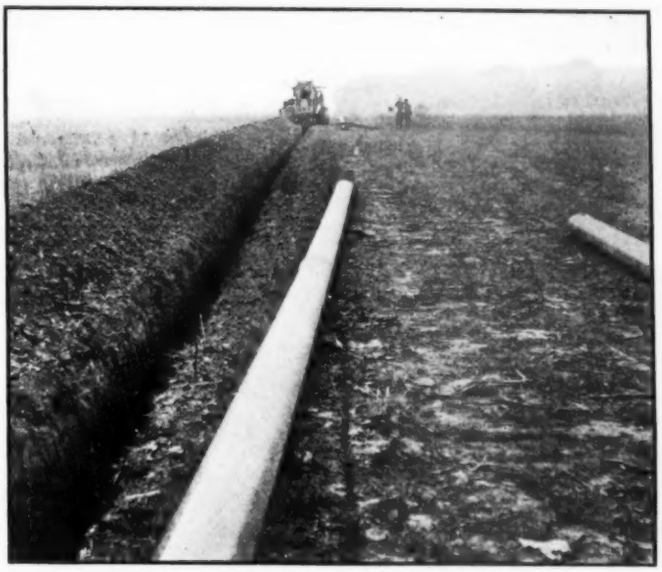
A section of the booklet is devoted to a brief discussion of a new welding technique which, the company states, produces welds equal to or better than the work metal in tensile strength, shock resistance, ductility and the ability to withstand repeated stresses. These characteristics are illustrated by photographs and descriptions of test specimens, macrographs, and photomicrographic studies.

The bulletin also discusses the production of alloy castings including the usual heat resisting alloys, the so-called stainless alloys, Nirosta KA^2, high chrome-iron and intermediate alloys to resist corrosion and withstand high temperatures. Typical castings are illustrated.

Copies of this publication may be had by addressing The Babcock & Wilcox Company, 85 Liberty Street, New York, N. Y.

THE PACIFIC PIPE AND SUPPLY COMPANY, Los Angeles, Calif., has recently published a leaflet covering the application of Papico Natural Gas Odorization Equipment. It is said that this type of equipment is used quite extensively to odorize the bulk of natural gas consumed in Southern California and many other districts.

SHAFFER TOOL WORKS, Brea, Calif., has recently issued bulletins on its newest fishing tools. Copies of the Shaffer Fluid Trip Rotary Jar Booklet and the Shaffer Inside Casing Cutter Folder may be had upon request.



Model 48—A Big Buckeye for the largest pipe line ditches. It cuts 6 different widths—22 to 40 inches; and any depth to 8½ feet. All dimensions inclusive. Note that this Buckeye is away ahead of the pipe gang.

Years of Satisfactory Service
Built Into Every Buckeye Pipe Liner

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With over thirty years of successful engineering and mechanical experience, the Buckeye operating principle and construction have been thoroughly tested and proven. Consequently, its endurance and efficiency may be accepted as fact—positive assurance that your money is safely protected.

Every prospective pipe line ditcher owner and user may have for the asking a copy of our interesting catalog, "BUCKEYE—The Pipe Liner". It contains comprehensive specification details, also authentic surprising performance records.

The Buckeye Traction Ditcher Co.
FINDLAY, OHIO

There's a Buckeye Sales and Service Office Near You

for over thirty years **Buckeye**

When writing THE BUCKEYE TRACTION-DITCHER CO., *please mention The Petroleum Engineer.*

It's now 100% STRONGER *but no heavier*

TRADE RIDGID
UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
THE RIDGE TOOL CO. ELYRIA, O.

There are RIDGID Pipe Wrenches Cutters. Vises & Threaders

WE'VE practically doubled the strength of the RIDGID Pipe Wrench — by increasing the strength of the metal. No mechanical change. No more weight. It still has all the RIDGID advantages — plus still greater power and stamina.

The housing is more unbreakable than ever, the sturdy I-beam handle nearly twice as powerful. You can't lock it on a pipe and it won't slip. Full floating hook jaw with pipe scale, RENEWABLE HEEL JAW, adjusting nut that spins easily in wide open housing.

No wonder the RIDGID *has won a remarkable place among pipe wrench users everywhere. Try one at your Supply Store.*

The RIDGE TOOL COMPANY, Elyria, Ohio

RIDGID
PIPE TOOLS

Henry McGraw Dies In Baltimore

THE Mid-Continent oil industry lost a popular, able, constructive and tireless leader through the death of Henry McGraw, vice-president and general manager of the Gypsy Oil Company, Tulsa, who succumbed June 19th from pneumonia, which developed after an operation at the Johns Hopkins Hospital in Baltimore, Md.

Mr. McGraw was born in Leavenworth, Kansas, May 19th, 1877. When the Cherokee strip was opened his parents moved to a spot near Ponca City, Oklahoma. This was in 1893. After attending public schools he entered the University of Kansas, but later finished his education at the University of Oklahoma, where he graduated from the school of law.

After practicing law in several cities, he went to Sapulpa, Oklahoma, then the center of oil activity, and practiced for several years, specializing in legal activities pertaining to land and leasing. He did much work for the Gypsy Oil Company and finally became identified with the company's legal department. He served in the land and legal departments for some time and was promoted to the vice-presidency of both the Gypsy Oil Company and the Gulf Pipe Line Company of Oklahoma in 1918, following the resignation of Murray M. Doan.

HENRY McGRAW

The Gypsy Oil Company enjoyed remarkable progress under the management of Mr. McGraw, expanding in both production and lease holdings until it was a power in the oil affairs of Oklahoma and Kansas. A tireless worker, Mr. McGraw was usually at his desk from one to two hours before employes began their daily work and many times worked hours after the employes had departed.

A phase of his life that many were unaware of was his aid to the needy. It is said that charitable work occupied much of his time and that he was a ready contributor to every

worthy cause for the benefit of the community. He never spoke of his charitable activities.

Surviving Mr. McGraw are one brother, T. F. McGraw, Newkirk, Okla., and four sisters: Mrs. Frank Jamieson of Tulsa, with whom he made his home, Mrs. John Hermes, Mrs. Dan Donahoe and Mrs. Robert Jamieson of Ponca City.

Funeral services were held June 23 in Ponca City, Okla., conducted by the Rev. Peter Kamp in St. Mary's Catholic Church, Monsignor J. F. McGuire, rector of Holy Family Cathedral, Tulsa, delivering the funeral oration.

Why Belts Should be Installed Correctly

By **W. F. Schaphorst, M. E.**

I HAVE frequently observed that when $1,000 is spent for a steam engine, electric motor, or similar mechanical equipment, installation directions are carefully followed. An expert is often employed to do the work.

But when $1,000 is spent for belting I find that it is not an uncommon practice to allow almost any mechanic to do the installing.

It is true that a college education is not necessary to correctly install belts, pulleys, and shafting, but there is more to it than merely cutting the belt, punching holes and then lacing.

One thousand dollars worth of belting can be ruined in a surprisingly short time if the shafts are not parallel, if the pulleys are not correctly aligned, if the belt is not cut to the right length and square across, and if the joint is not properly cemented or laced.

Novices should not be permitted to install expensive belts for the same reason that they are not allowed to install important steam or electrical machinery. After a belt is once cut too short it cannot be easily lengthened. There should be no guesswork about how long any belt should be cut. It is better to cut a belt too long, yes, but why not cut it "just right?" Cemented belts must be cut longer than laced belts. Many thousands of dollars worth of belting has been cut up and destroyed by non-thinking belt installers who cut the belt too short and then "stretched" it to make the ends meet.

If a belt is too tight when first placed on the pulleys, it will be ruined prematurely due to over-stressing. Bearings sometimes get hot owing to tight belts. Much power may be lost because of excessive tightness and the resulting sprung shafts. Novices are not aware of most of these facts.

Knowledge of belting is easily acquired. Before allowing your belt operator to cut up good belting be sure that he knows the rudiments of belt installation.

Take a thing as "trivial" as cutting the belt: Unless the belt is cut "square across," using a carpenter's or other square, the belt will not run evenly and there will be greater stress on the short side than on the long side. The short side therefore is weakened first. Uneven running is a common cause of running off. Belts that continually run off are notoriously short-lived.

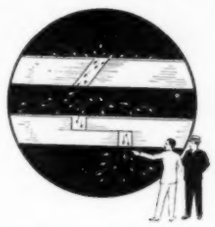
Shafts out of parallel and poorly aligned pulleys are both common causes of belts running off.

All of these points must be known and kept in mind by the belt installer. They are simple, yes, but very important and valuable.

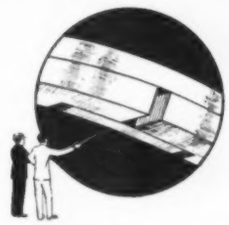
AT a meeting of the Board of Directors of The Gray Processes Corp. held on July 2, 1931, Mr. A. McD. Gray was unanimously elected president of the company. Mr. A. McD. Gray is filling the vacancy caused by the death of his brother, Thomas T. Gray. Mr. A. McD. Gray has been associated for the past thirty years with the oil refining equipment business and has obtained numerous equipment patents pertaining to the industry.

Now! more POWER with

SEALING RINGS

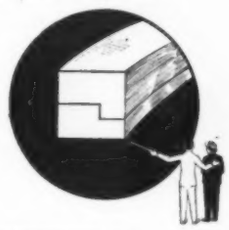


In ordinary rings compression leaks through the joint openings causing a great loss of power—a costly waste of fuel.



The COOKTITE Patented Groove seal prevents the escape of pressure that enters behind the ring through groove and upper ring joint clearances.

The COOKTITE construction prevents compression blow-by—there are no openings through which the pressure can escape.



COOKTITES have full depth radial strength and single ring groove bearing—providing greater reliability and elimination of groove stepping.

JUST a fad they called it a few years ago. Today the COOKTITE Sealing Ring is helping the operators of gas and Diesel engines to a truer realization of power economy. Even in worn cylinders more power is developed. In every case cylinder reboring has been indefinitely postponed. Install COOKTITE Rings now for higher efficiency and reduced maintenance costs. Write for complete information.

C. Lee Cook Manufacturing Company, Incorporated, Louisville, Ky. Distributors New York, Chicago, Tulsa, Los Angeles and San Francisco.

COOK'S GRAPHITIC IRON Piston Rings

"Sealing Pressures Since 1888"

When writing C. Lee Cook Mfg. Co., *please mention The Petroleum Engineer*

An Amazing Underground Recording Job

by an ingenious instrument which enables well drillers and owners to conduct their activities with a true knowledge of actual conditions. A recording job that makes possible the elimination of crooked holes and their dire results.

If you're off the vertical the SYFO Clinograph will tell you accurately *HOW MUCH.* It will tell you on paper—a permanent and easily read record. The SYFO makes unnecessary the use of dangerous acids.

The operation is speedy—the cost less than that of the acid bottle—the resulting information invaluable.

Write for literature and costs on this service.

Also makers of the SUR-WEL Clinograph, the gyroscopic surveying instrument that tells both the degree and direction of the deviation.

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Tyler, Texas: Bell Building
Calgary, Alberta, Can.: Room 1, Central Block

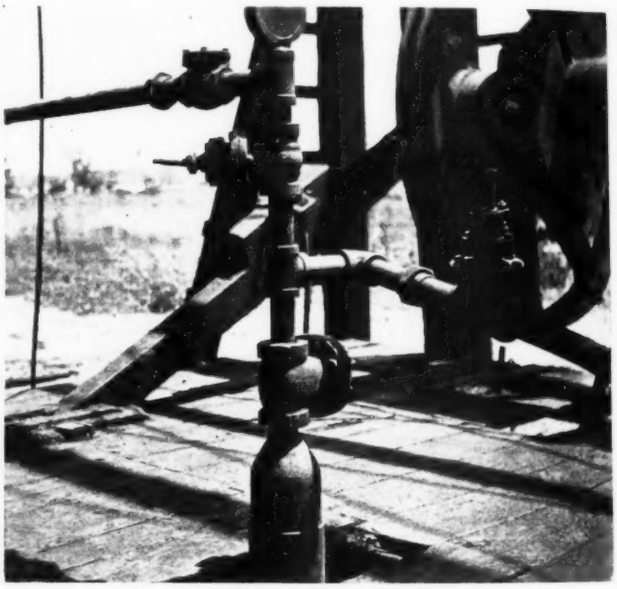
SYFO *Clinograph*

Injecting Gas into

THE injection of bubble tower vapors into wells for storage purposes has been a very interesting experiment conducted in the Seminole field by the Sinclair Oil and Gas Company. The experiment, while still lacking a large amount of specific information, has shown that residue gas is a better injection fluid for storage purposes than vapors and that storage of the former is both practical and efficient.

About a year ago it was decided to try storing some of the gas popping into the air at the company's gasoline plants. Some of this gas was residue and part was vapors from the bubble towers. As the tower vapors were undesirable in the fuel system these vapors were first introduced in the storage well.

The first well selected for input was Sinclair Company's B. Cudjo "A" No. 4, located in the southeast corner of the northeast quarter northwest quarter section 35-9-6, near the center of the Seminole City pool. This 80-acre tract



Sinclair's B. Cudjo "A" No. 4, showing how it is equipped to receive the injection fluid.

has produced an average of nearly 53,000 barrels of oil per acre. At the time injection was started the selected input well was pumping only five barrels of oil per day. Injection was started on June 9, 1930, at the rate of 260,000 cubic feet of bubble tower vapors daily.

An analysis of these vapors follows:

Methane	Trace
Ethane	0.576
Propane	87.182
Isobutane	4.378
N Butane	7.864
Specific Gravity	1.584

The tubing was removed from the well and the gas injection line swedged directly into the casing. The well head injection pressure was only seven pounds when intro-

When writing SPERRY-SUN WELL SURVEYING Co., *please mention The Petroleum Engineer*

Wells for Storage

ducing at the rate of 260,000 cubic feet daily. The volume going into the well had been increased by January 31, 1931, to an average of 526,000 cubic feet per day with a pressure of only 11 pounds at the well head.

A verbal agreement was made with all of the companies owning offset acreage before beginning the injection of gas. This agreement permitted the Sinclair engineers to watch the producing oil and wet gas from all of the surrounding wells and allowed them to apply any reasonable amount of back pressure necessary to prevent channeling.

All of the gas entering the well has been metered. Meters were set on all offset producing wells for the purpose of measuring the wet gas in order to detect any increase. These meters were set and the gas measured along with individual oil gauges of each well for two weeks prior to the time injection was commenced.

Seven days after injection was started a slight increase in the gas at Sinclair Oil and Gas Company's B. Cudjo "A" No. 2, a direct west offset, was noticed. The addition of one pound back pressure was sufficient to hold the wet gas production from this well to normal for several months, then it became necessary to increase the back pressure to three pounds. No effect on the oil production from any of the surrounding wells has ever been noticed.

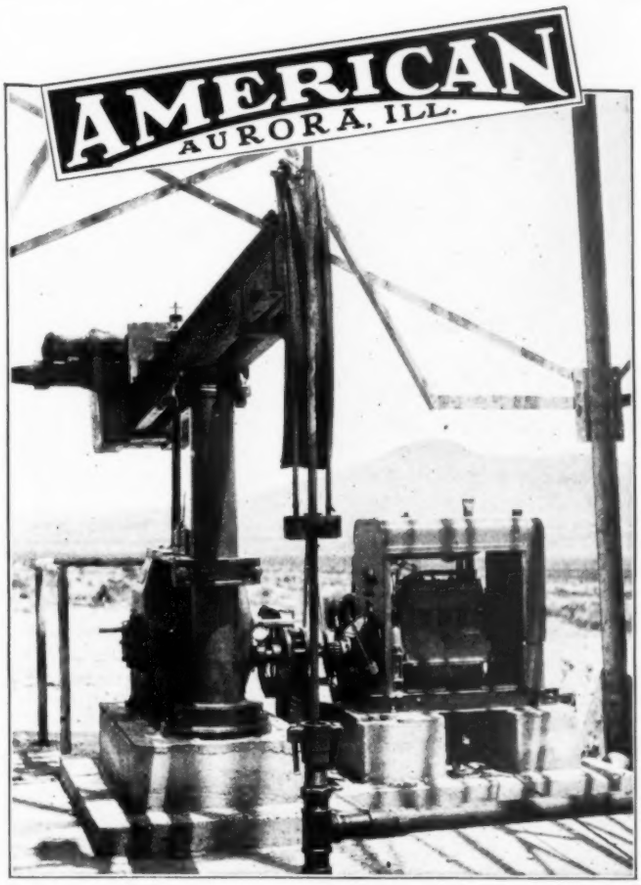
On February 1, 1931, the company switched from bubble tower vapors to residue gas and at the present time the injection rate is 950,000 cubic feet of gas with a well head pressure of 27 pounds. A total of 210,000,000 cubic feet of gas has been injected into the well to date.

An agreement was made between the Barnsdall Oil Company and the Sinclair whereby the latter was to furnish and inject bubble tower vapors into the latter's well L. Jones No. 3, an offset well located in the southeast corner of the northeast quarter northeast quarter Section 34-9-6, one-half mile straight west of Sinclair's original injection well. The volume at this well has been slowly increased from an average of 96,000 cubic feet per day with a well head pressure of 35 pounds to the present rate of 250,000 cubic feet with a well head pressure of 60 pounds. Bubble tower vapors have been injected all the time into this well. Approximately 65,000,000 cubic feet has been introduced with no noticeable results.

On the eighth of November, 1930, Sinclair commenced putting bubble tower vapors into its M. Taylor No. 1, in the southwest corner of the northwest quarter southeast quarter Section 10-8-6, Bowlegs pool, a well pumping five barrels of oil daily. Considerable difficulty has been encountered in getting this well to take any gas with the available pressure of 115 pounds.

Lloyd Holsapple, district engineer for the Sinclair Oil and Gas Company in the Seminole area, states his observation leads him to believe the bubble tower vapors go into solution with the oil in the sand.

The company continues to inject bubble tower vapors thinking results will be slow in showing and eventually the cleaning action, and possibly the reduction in viscosity, will prove worth while. Wet gas produced from the B. Cudjo "A" lease has shown a little higher raw gasoline content, but weathers to normal. No increase in gravity of the oil produced on these leases has occurred.



An **"AMERICAN"** *with Gas Engine*

Pictured is an "American" No. 4-A Fig. 1822 oil well pumping unit connected to a gasoline engine.

"American" units have been particularly designed to meet the various drive requirements of different localities.

"American" units are adaptable for pulley, V-belt or direct drive by gasoline engine or electric motor.

Detailed figures and engineering data of typical installations of this equipment in both this country and others are available. Ask for them!

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THE AMERICAN WELL WORKS
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Instruments in the Refinery and Natural Gasoline Plant

By W. C. BEGEEBING, *C. J. Tagliabue Mfg. Co.*

WITHIN recent years indicating, recording and controlling instruments have definitely been adopted by the refining and the natural gasoline industry and the employment of these aids to accurate, economical and efficient operation is now regarded as a necessity.

This series of articles will examine in detail the various types of available equipment and, it is hoped, will thus aid in the discriminating selection, most effective use, proper maintenance and testing, and hence best results from this type of equipment. Practically every man in the industry is more or less concerned with this subject—the total investment in this equipment represents a huge sum—and therefore a better acquaintance with all its phases should be of general interest and value.

For an orderly presentation, the subject has been divided into several chapters. In each chapter the various types, constructions, applications and uses will be discussed. Instead of separately discussing the applications or processes and the reasons for the use of instruments thereto, we will illustrate by specific example the general application principles involved.

AUTOMATIC temperature controller for top tower regulation needs no brief for its continued use—it is accepted by the industry as a necessity for efficient operation.

Methods of control vary with the type of tower. The air-cooled tower is such a rarity that it will not be covered. Cooling is sometimes accomplished by a closed coil through which the feed for the unit is circulated, the coil being by-passed and the diaphragm valve placed in this by-pass. Or an oil or water-cooled reflux condenser mounted above the tower is employed in which case the diaphragm valve is placed in the reflux line back to the tower. The method most favored is regulation of the amount of reflux pumped back into the tower and the variations of this method will be treated in detail.

On the hundreds of automatically controlled towers in the oil and natural gasoline industry details of this type installation vary considerably, but basically there are only three different hook-ups and they are distinguished from each other only as to the method of altering the amount of reflux. The installation of the temperature controller itself is always the same; the socket or well being located in the vapor line and the instrument itself at some point convenient to the operators so that changes in temperature setting can be quickly and conveniently made.

The three control methods are:

(1) Controlling the steam to reciprocating pumps (in conjunction with which is recommended a steam pressure regulator or controller to supply a uniform steam pressure to the temperature-controlled valve).

(2) Controlling a diaphragm valve on the reflux line between the tower and a steam driven reciprocating reflux pump (in conjunction with which a pressure regulator or controller is necessary to maintain a uniform reflux pressure to the temperature-controlled valve).

(3) Controlling a diaphragm valve on the reflux line between the tower and a steam or electric-driven centrifugal or constant speed pump (in conjunction with which a relief valve is desirable in a by-pass line from outlet to inlet of pump).

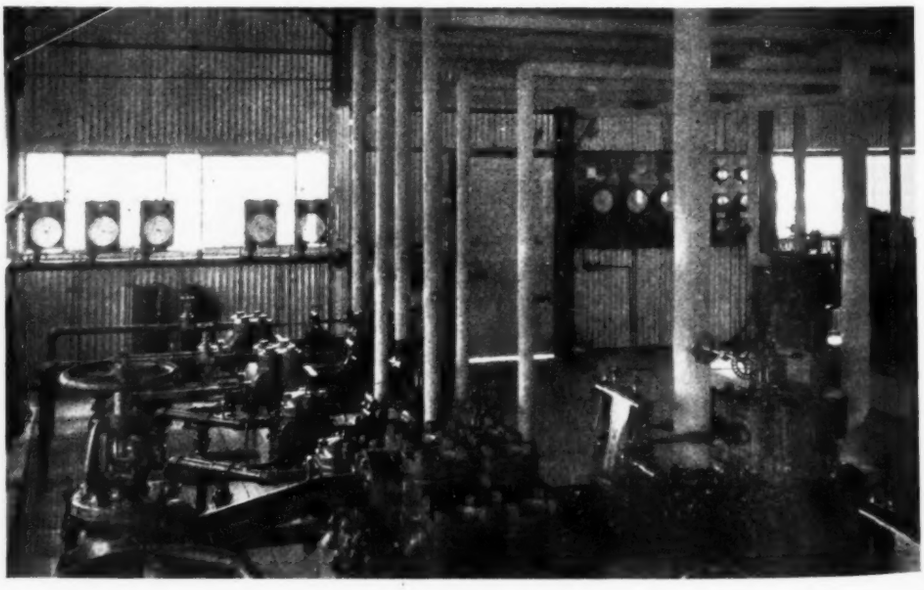
The various methods of control are all being accomplished by the following different classes and types of temperature controllers whose advantages and limitations are briefly summarized. Only pilot-operated controllers are used for tower service.

Recorder-Controllers—Most desirable. Allows direct setting of control point. Provides a permanent record. Instrument can be located in control house. Mercury-actuated somewhat more desirable than vapor-tension because of wider operating ranges. Mercury or vapor tension preferable to gas-filled because of latter's sluggishness.

Indicating-Controller—Identical to recorder-controller except indication instead of record. Used when temperature record is otherwise obtained (as from multi-point electrical recorder).

Non-Indicating Controllers—Arbitrary reference points instead of calibrated temperature scale, hence direct-setting impossible except by experience or on-the-job calibration. Lower priced than either of above and also somewhat less flexible in "swing" adjustability and performance.

Expansion Stem Non-Indicating Controllers—Fixed stem



Control instruments at Sugar Creek, La., natural gasoline plant.

The Answer to YOUR Question:

"What do WE need in HIGH PRESSURE VALVES?"

Is made by EDWARD:

"STRENGTH, STAMINA to withstand gruelling service through wide temperature ranges, and LOW LIFETIME COST!"

Try EDWARD VALVES one time—then change back—if you can!

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SPECIALTIES FOR PRESSURE AND TEMPERATURE

NATURAL GAS FROM TEXAS TO CHICAGO

Workmen near Lemont, Illinois, are shown rushing to finish the last section of a pipe line 960 miles long between Chicago and the fields of Amarillo. This section of the line was treated with the NO-OX-ID Master Coat for the Will-Cook Construction Company.

Illustration shown through courtesy of the Chicago Daily News.

The NO-OX-ID Master Coat consists of:

(1) Dearborn Pipe Mill Coat. This coat is to give protection to pipe in transit.

(2) NO-OX-ID "G" Special, the rust preventive unequalled, which combines chemical rust inhibition and mechanical soft non-drying protection.

(3) NO-OX-ID-IZED Wrapper, is supplied in a form complying with the requirements of the job. Applied spirally.

(4) NO-OX-ID Service Coat gives a film effective in resisting soil stress which does not become hard and brittle on aging.

If you are not entirely familiar with the NO-OX-ID Master Coat, let us submit facts and estimates on both new and reconditioning work.

DEARBORN CHEMICAL COMPANY

310 S. MICHIGAN AVENUE, CHICAGO
205 EAST 42nd STREET, NEW YORK
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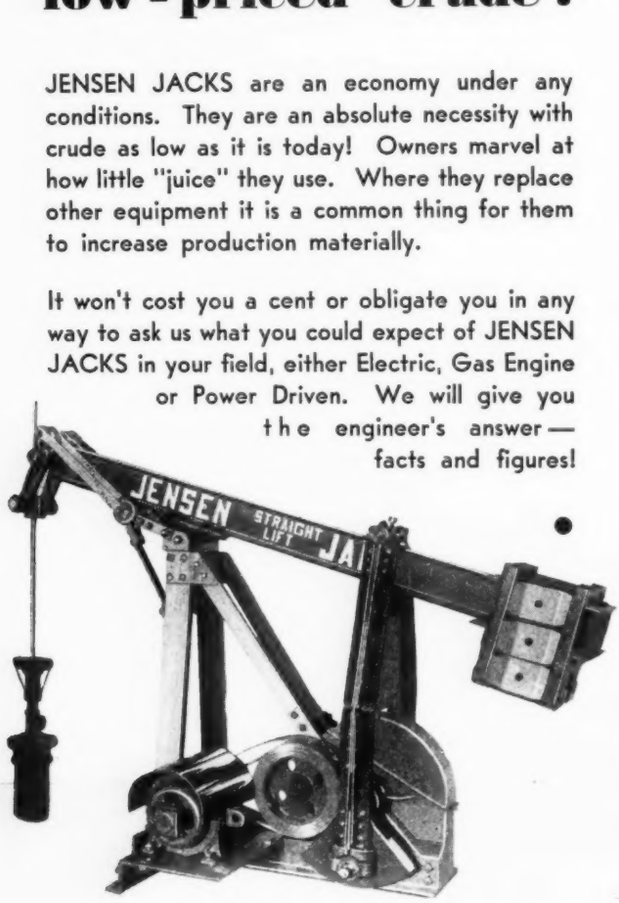
It won't cost you a cent or obligate you in any way to ask us what you could expect of JENSEN JACKS in your field, either Electric, Gas Engine or Power Driven. We will give you the engineer's answer—facts and figures!



Dunigan Tool & Supply Co., Breckenridge, Texas.

Jensen Brothers Mfg. Co., Buffalo Warehouse, Houston, Texas.

Petroleum Equipment Co., 2800 South Alameda St., Los Angeles, Calif.

Export Office, 136 Liberty St., New York City, U. S. A.

JENSEN BROS. MFG. CO.
Coffeyville, Kansas, U.S.A.

construction requires inconvenient mounting of entire controller on vapor line or tower top. Direct setting not provided. Expansion stem precludes use of socket, hence maintenance cost higher. Low priced, quite sensitive and generally rugged.

Extremely uniform temperature control can be realized by hook-ups such as these. A typical chart obtained from the vacuum tower of a two-stage distillation unit is reproduced herewith. The chart from the atmospheric tower is equally good. This control was achieved by mercury-actuated, air-operated recorder-controllers.

Before leaving this subject, mention should be made of the advanced types of air-operated and electrical controllers for top tower and furnace temperature regulation. Since a thorough discussion of the various modes of control achieved by these instruments requires a detailed exposition it has been thought best to devote a separate chapter to it.

Rectifier Temperature Control

Perhaps no piece of refinery equipment is so universally controlled automatically as the rectifier or stabilizer. In this apparatus temperature, pressure, flow and level control are all combined and co-ordinated to produce the desired product by entirely eliminating the wild constituents.

By separating the desirable and merchantable normal butane, pentanes and hexanes from the propane, ethane and lighter fractions in the stabilizer requires accurate temperature control for the process is obviously a temperature one throughout. The critical separation is between the butane and propane and as the vapors ascend the column and the liquid descends a fractional condensation and revaporization takes place on every tray so that the butane is progressively replaced by propane ascending the column and the tray temperatures increase from top to bottom. Thus success depends on a smooth temperature gradient from the top to the bottom of the stabilizer column.

Heat for the kettle or reboiler at the bottom of the column to vaporize the lighter products is supplied by steam. The automatic control at this point establishes and maintains the high temperature extreme of the gradient.

Cooling for the top of the column to prevent the escape of desirable constituents is accomplished by washing back reflux. By automatically controlling the reflux, the low temperature extreme of the gradient is fixed.

The back pressure on the system is automatically regulated not because the pressure itself governs the process, but because the pressure determines the operating temperatures. The higher the pressure the higher the operating temperatures. Inasmuch as the temperature at the top of the column should be high enough to operate with atmospheric cooling, high pressures are usually employed even though this entails the use of live instead of exhaust steam to obtain the correspondingly higher kettle or bottom temperature.

The automatic control of the bottom temperature is almost invariably obtained with a mercury or vapor tension air-operated controller or recorder-controller handling a diaphragm valve on the steam line.

The automatic control of the top temperature is accomplished by a similar type controller or recorder-controller with its bulb in the vapor outlet and the diaphragm valve on the reflux line either from the reflux condenser or the reflux pump if the condenser is located below. Another method is to automatically vary the amount of water flowing through the reflux condenser by means of a controller with its bulb in the vapor outlet from the column. In this method, all the reflux which is condensed returns to the tower as a reflux-wash.

When writing JENSEN BROTHERS MFG. CO., *please mention The Petroleum Engineer*

American Gas Association to Establish Testing Station on Pacific Coast

BEARING in mind the thought of further raising the high standards maintained by the industry, the American Gas Association has decided to establish an inspection station of its Testing Laboratory on the Pacific Coast, and it will be located at Los Angeles, California.

It was pointed out by members of the Laboratory Managing Committee that freight and express charges on equipment shipped to the Testing Laboratory at Cleveland for approval are more than twice as high for manufacturers on the Pacific Coast as for concerns located in the Eastern States. However, as it is not planned to establish an Approval Testing Station on the Pacific Coast, this item will be of consequence only when it is necessary for appliances to be returned for correction. Such additional expense, it is explained, undoubtedly could be avoided, at least in part, were appliances given a careful inspection before they are shipped to the Laboratory at Cleveland.

Summer Course in Refining Engineering

THE Massachusetts Institute of Technology, Boston, will offer special courses in petroleum refining during the summer session, from July 20th to August 21st. A seminar on refining will be conducted by Doctor W. K. Lewis, professor of chemical engineering. He will also give a course in distillation, rectification, and absorption. Doctor T. K. Sherwood will give a course on the dynamics of fluids and flow of heat. The courses will deal with the fundamentals and basic theory underlying good engineering practice.

Sperry-Sun Opens Texas Office

TO meet the increasing demand for SYFO and SURWEL surveying service in the East Texas Field, the Sperry-Sun Well Surveying Company, of Philadelphia and Dallas, have opened an office in the Bell Building, Tyler, Texas, where several engineers are located, available for giving immediate service.

Operators and drillers who are aware of the disadvantages and ultimate greater cost of crooked holes will be glad to know that the Sperry-Sun organization, which operates two of the best well surveying instruments, is represented and its service is immediately available in the East Texas Field.

Axelson Reports Increase in Export Business

A GRATIFYING increase in export business is reported by the Axelson Manufacturing Co., Ltd., Los Angeles, builders of various production equipment for the oil industry. These orders are distributed over a wide area, ranging from Sarawaki, Burma, Venezuela and Colombia to Roumania and the Argentine. Mr. R. M. Humphreys, assistant to the sales director, in speaking of the increase of foreign business, says:

"Although general conditions are still reported to be somewhat curtailed in foreign fields, we have tangible proof of a material improvement in our particular line of manufacturing. The diversified character of our orders lead us to believe that a marked increase may be found in all the related branches of the oil equipment business. Foreign buyers are turning today more than ever to reliable American manufacturers who are noted for high quality products, designed to give maximum efficiency."

Keep Out the SAND
Let in the OIL

THE LAYNE

MILLED GROOVE SCREEN

That's the purpose of a screen. And the Layne Milled Groove does the job better. There is no possibility of sand cutting or clogging.

The Milled Groove gives a greater inlet area, and thus increases production. Many records show that installing the Layne Milled Groove Screen has increased production 33⅓% and in numerous cases as much as 100%.

The Keystone wire wrapping is the patented process which does the separation job to perfection. It prevents clogging and cutting.

If you want to keep the sand out and let MORE OIL in install Layne Milled Groove Screen.

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When writing LAYNE & BOWLER CO., *please mention The Petroleum Engineer*

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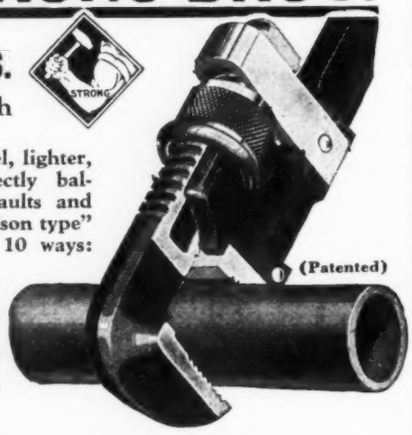
Patented Pipe Wrench



A truly fine tool—all steel, lighter, handier, stronger, perfectly balanced—free from the faults and weakness common to "Stilson type" wrenches. Improved in 10 ways:

1. No "frame" (cast nut housing).
2. Nut cannot fall out when jaw is removed.
3. Heavy forged side lugs take up side strain.
4. Ball and socket nut with extra large bearing socket.
5. Improved spring action.
6. Handle strongest (instead of weakest) at point of greatest strain.
7. No projections below line of handle.
8. Self-cleaning, cannot "gum up."
9. Replaceable tool steel jaws.
10. Perfect balance.

ARMSTRONG BROS.
Improved CHAIN TONGS

These tongs have EXTRA strength, are handier. They are built to stand up under the hardest usage and give long service. Sizes for ⅛" to 18" pipes. Flat or link chains, standard or "Reversible" jaws.

Handles are forged from high carbon steel; have both stiffness and spring.

Jaws are drop forged from special steel; are treated, hardened and tested for toughness and wearing qualities.

Chains. Each chain is proof tested to ⅔ catalog strength — 3,600 to 40,000 lbs. Each carries an Arm-and-Hammer seal as evidence of its proved strength.

Design. Bearing of jaws on bar is greatly increased. Jaws are held securely in place by large hardened steel bolt. Lugs forged in jaws serve as chain guides — prevent chains from jamming.

Write for Catalog P-10

It shows, describes and gives prices of all ARMSTRONG BROS. Pipe Tools—the most complete line of pipe tools made — each is an improved tool designed after exhaustive tests of other types and makes. These "Better Pipe Tools" are distinguished by the Arm-and-Hammer Trade Mark.

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Crooked Holes in East Texas Fields

THE rapid development of the East Rim fields in East Texas has drawn the attention of all operators and geologists to that district. The relatively soft formations and the haste to reach the pay have encouraged fast drilling. Moreover, many of the wells are being drilled by the smaller operators, without any precautions against crooked holes. This rapid drilling without checking has caused numerous crooked holes, some of which have already been very expensive due to the necessity of plugging back and redrilling, while others were not discovered until after casing was set. The expense of these will come out later when the wells are put on the pump.

Numerous examples of crooked holes may be quoted.

In one case in the Joinerville pool, it was necessary to plug back and *redrill over one thousand feet of hole.* This well had reached a depth of thirty-three hundred feet without being checked for verticality. A survey for deviation was then made and the well was found to be approximately 20° off the vertical at twenty-five hundred feet, and over 50° off near the bottom.

In another case no tests for verticality were made until after the casing was set, the tests then made showed the hole to be straight to 500 feet, 15° off at 2,000 feet, 30° off at 2,500 feet, and 15° off at 3,600 feet, the bottom of the casing. It is obvious that when this well is put on the pump the lifting cost will be prohibitive.

On another well, a verticality test was made and the well was found to be off 43° at 2,500 ft. This well, of course, was plugged back and redrilled.

Another well in Rusk County was about three miles west of the nearest production at the time it was completed, several weeks ago. This well reported a subsea depth of 3,365 feet without any sand. As the estimated subsea depth of the Woodbine sand in this well was not much below minus 3,300 feet, the belief gained that the hole must be crooked. Finally a rich oil sand was cored, and casing was set on top of the pay at 3,375 feet.

Prior to bringing in the well, a directional survey was ordered to be made by the Sperry-Sun Well Surveying Company, using their Surwel Gyroscopic directional surveying ing instrument for this purpose. Although, as is usual in such cases, the results of this survey were held strictly confidential, the owner has now kindly agreed that these results may be published.

This survey showed that the maximum deviation from the vertical was 21° with several very abrupt changes. At one depth the angle of deviation changed from 21° to 10° in the length of one fourble (about 90 feet). The bottom of the hole was found to be two hundred and twenty feet in a northwesterly direction from the mouth and the vertical correction in depth was forty-two feet.

This correction applied to the reported depth of the hole, placed in the top of the producing sand at 3,323 feet below sea level. Since the completion of this well, the Magnolia Company has drilled an offset on the south with the top of the sand at minus 3,317 feet, and the Shell Corporation has drilled an offset on the east with the top of the sand at minus 3,310 feet.

The resumption in East Texas by many operators of the old "hurry up" drilling methods is in direct contrast to the orderly, careful drilling programs with which the majority of the more recent fields have been developed. The many disadvantages of crooked holes and the accompanying increase of cost of operating is well known and it is very surprising that at this time, when economy is so essential, any operator would be so careless as to allow wells to be drilled

without accurate information as to their straightness.

These examples as described above indicate clearly the advisability of using an instrument (such as described by Mr. H. L. Strader, Petroleum Engineer, South Texas Division, in the April issue of the "Texaco Star" and in "The Dallas Morning News" of Sunday, May 10, 1931) for daily checking of the vertical deviation while drilling, thus enabling the driller to correct immediately any deviation recorded.

The examples also show the need of receiving a directional survey with a reliable instrument when approaching the pay sand. A directional survey would give the producer and his geologist the exact location of the bottom of the hole, which, even if held within three (3) degrees from the vertical at a depth of 3,600 feet, may be one hundred and eighty-five feet (185 feet) distant from the anticipated location.

Prairie Using Spudder in Kansas

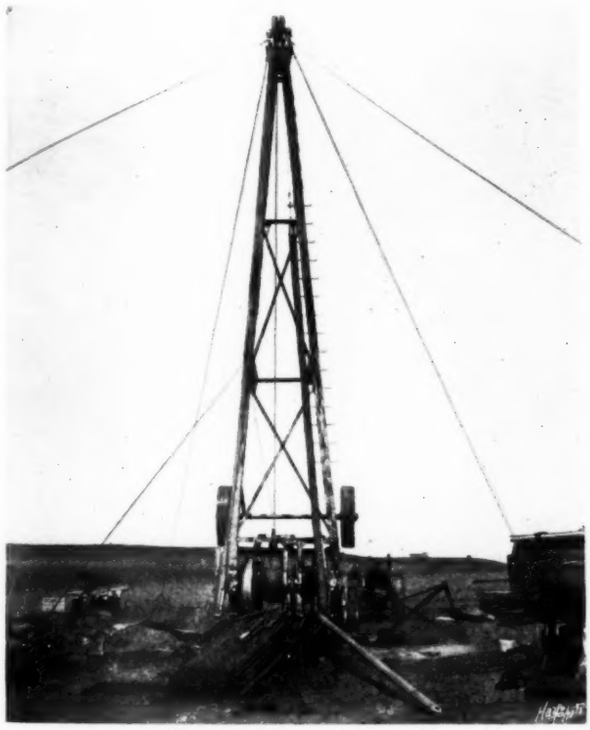


ILLUSTRATION shows Moore Champion Spudder in use on Prairie Oil & Gas Co.'s lease in Kansas. The efficient spudding motion, the sturdy construction and the ease of transporting from well to well make this new machine especially suited for cleaning out and deepening old wells.

Belgium Refinery Buys New Equipment

COMPAGNIE FINANCIERE BELGE DES PETROLES SOCIETE ANONYME "PETROFINA" S A of 111 Rue du Commerce, Brussels, Belgium, has ordered a complete natural gasoline stabilizing unit for their refinery in Belgian Congo, Africa. This stabilizing unit is being fabricated by Southwestern Engineering Corporation of Los Angeles, California.

T. P. Granted Patent

THE United States Patent Office today issued to the Texas Pacific Coal and Oil Company of Fort Worth, Texas, a basic patent on dewaxed paraffine base lubricating oil.

B A R O I D

EXTRA HEAVY COLLOIDAL DRILLING MUD

BAROID is a uniform, high-grade specially prepared pulverized weight material for increasing the weight of Drilling Mud to overcome high gas and water pressures. It is packed in 100-lb. sacks and carried in stock in all oil fields.

BAROID has a specific gravity of 4.2 and enables the preparation of pumpable muds weighing 140 to 150 lbs. per cubic foot. Drilling muds made up from BAROID will not settle out if circulation is suspended and eliminate danger of stuck drill pipe and fishing jobs. Write for literature.

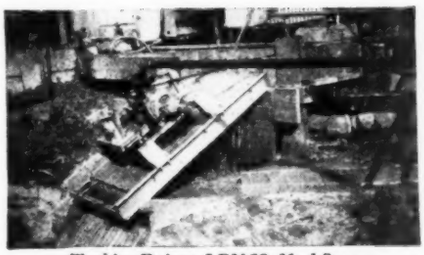
AQUAGEL

TROUBLE PROOF COLLOIDAL DRILLING MUD

AQUAGEL is a uniform, specially treated, high-grade clay packed in 100-lb. sacks and carried in stock in all principal oil fields. Mixed with water, in the proportion of 3% by weight, one ton of AQUAGEL makes 180 bbls. of Drilling Mud.

AQUAGEL prevents caving, stuck drill pipe and casing, loss of circulation, mudding off of low-pressure sands and gas-cutting. Lubricates drill pipe and walls of the hole. Write for literature.

LEMCO MUD SCREEN



Turbine-Driven LEMCO Mud Screen

A trouble-proof mechanically vibrated screen for removing sand and shale from Drilling Mud. Saves its cost many times over by reducing abrasion of pump parts, by reducing quantity of clay or weight material purchased and by elimination of construction costs for mud ditch or slush pit.

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A new and improved trouble-proof device—easily installed—for continuously indicating and recording on a chart the true weight of your mud. An important safeguard against danger from blowouts.

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Organized 1884—Oldest Builders of Gas Regulators in the Country. Built in all sizes, from 1 inch to 24 inches; for all service. 1 oz. up to 2,000 lbs. pressure to square inch.

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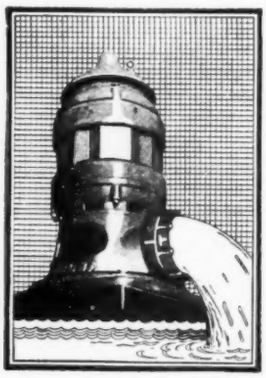

Making Important Water Pumping History . .

The importance of the refinements introduced by the Pomona Pump to water development have been so far-reaching that they mark a new epoch in pumping. Greater economy, longer life, smoother operation and water lubrication have each been major turning points which have made important water pumping history.

THE SHULER COMPANY, 1138 West 37th St.
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POMONA PUMP CO., POMONA, CALIF.

POMONA

WATER LUBRICATED

TURBINE PUMPS

Have you any interesting Oil Industry pictures?

. . . For use in the Pictorial Petroleum Section, The Petroleum Engineer desires unusual and interesting photographs. These may be of field scenes, new installations, new hook-ups, individuals, or any subjects likely to appeal to men in the petroleum industry. Especially do we want pictures of "old-timers" who are still active in the business and views with a foreign setting.

If you have such photographs, we shall appreciate your permitting us to reproduce them in our pictorial section. Extreme care will be exercised in handling them and they will be returned in the same condition as received. Kindly address photographs to

THE PETROLEUM ENGINEER

Exchange Bank Bldg. Tulsa, Okla.

Barnsdall's Okmulgee Plant

THE picture shown on the front cover of this month's issue is a recently taken photograph of the Barnsdall Refining Company's plant at Okmulgee, Oklahoma, which a short time ago was completely remodeled into one of the most modern type refineries in the Mid-Continent.

The refinery is located on the southern edge of the city of Okmulgee, one of the pioneer oil cities of the state. It is picturesquely nestled at the bottom of a small, round knoll, along the sides of which are located the plant's storage tanks. U. S. Highway No. 75, a fine, paved road, and the main thoroughfare from Tulsa to the Greater Seminole oil fields, runs through the grounds, offering travelers a wonderful opportunity of a close inspection of a modern gasoline plant. Travelers often stop to gaze at the massive equipment required to produce the present-day high quality gasoline that we, without thinking of the various stages it has been through before it is ready to burn in our automobile motors, put into our car tanks.

The new installations at the plant include a combination reducing and cracking unit, incidentally the first of its type in the United States. The units can be operated as a pipe still or a cracking unit, or in combination. Another modern new part of the refinery is the gasoline recovery plant, consisting of a compression type plant and a stabilizer for stabilizing the raw gasoline.

A feature of the plant's operation is its practically complete automatic control. This adds much to the safety and ease of working conditions, since pressures are not apt to become too severe. Automatic pressure and water level controls are used in the boiler house. Water for use in the boilers is supplied by drilled water wells, which are pumped by electric turbine type pumps.

The Okmulgee plant, one of the three operated by the Barnsdall Company, the first refiners in the world, has a daily crude capacity of 10,000 barrels and is operated on Seminole and Bristow, Oklahoma, districts crudes, both high gravity, high gasoline content, and good lubricating oils. This particular refinery is essentially a gasoline manufacturing plant, and here much of the "B" Square motor gasoline, including the Ethyl grade, is made to be distributed to the public consumers.

The company is keeping abreast of the times, having adopted the latest means of carrying refined gasoline to heavy consumption centers. It is interested with several other companies in the Great Lakes Pipe Line Company, which is completing a line from Oklahoma to northern markets through which gasoline will be pumped. The Barnsdall Okmulgee refinery is connected to this line by a six-inch lateral running from a point on the main line. Gasoline has already been pumped through a part of this line and the remainder of this year will see the first attempt in the Mid-Continent to transport gasoline long distances by pipe line become a thing of reality. The line will enable the partnership owning companies to move gasoline by this method as far as Chicago, Minneapolis and that region. The refinery is also ideally located for rail shipments, having trackage on two railroads, and fine roads offer good truck hauling as another medium.

Important Merger

EFFECTIVE July 1, the Fluid Packed Pump Co., Mid-Continent organization, with general offices in Oklahoma City, merged with the Robert J. Miller Company, Houston, Tex., both distributors of Fluid Packed Pumps and Shaffer Tool Company products. The new organization takes the name of Fluid Packed Pump Co., Mid-Continent. R. E. Grinnell heads the organization, while R. J. Miller remains in charge of the Texas district with offices in Houston, Tex.

Gott Water Cans 1½ gal., 3 gal., 5 gal. and 10 gal.

Gott Water Coolers 3 gal., 5 gal., 8 gal., 10 gal. and 20 gal.

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Keep Pure Water Always Handy

H. P. Gott Mfg. Company

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DEPENDABLE Oil Field Lighting by PYLE-NATIONAL

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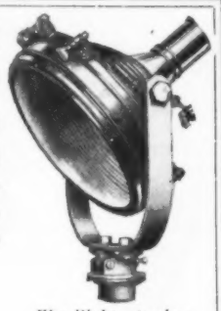
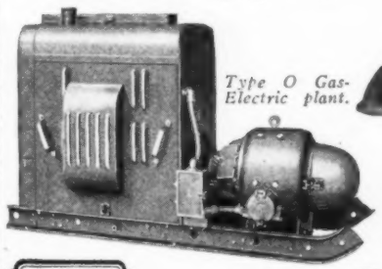
—Accessory equipment



Floodlight projector, for yard or filling station illumination.



Type O Gas-Electric plant.

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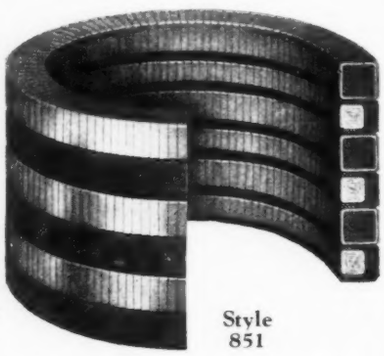

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Allis Chalmers and Advance Rumely Companies Merge

ON May 29th, the officials of the Advance Rumely Thresher Company and the Allis Chalmers Manufacturing Company consummated a merger of the two companies, consolidating two of the largest manufacturers in their respective fields.

Allis Chalmers, until recent years, has been better known in other industries than in the agricultural field. A few years ago they entered that field and rapidly developed into large builders of four-wheel tractors. Later they acquired the Monarch line of Crawler tractors and now with the acquisition of the Rumely line the company becomes a stronger part of the tractor industry.

While the Rumely organization is operating for the present as a separate unit, both the Rumely and Allis Chalmers customers are assured of bigger and better service.

Natural Gas Production Increased Four Times; Consumers Multiplied Six Times

SINCE 1920 the output of natural gas in the three largest producing states, Texas, Oklahoma and California, has increased approximately four times, while the number of users has multiplied more than six times, according to a bulletin issued by Appalachian Gas Corporation. The production of the three states in 1930 was 1,015,000,000,000 cubic feet against 256,000,000,000 cubic feet in 1920. In Texas, Appalachian Gas Corporation is engaged in all three branches of the natural gas industry, production, transportation and distribution, through its wholly owned subsidiary, Texas Gas Utilities Company, besides operating through ten other subsidiaries and affiliates in the Appalachian field and the Monroe field of Louisiana.

"Texas, with a greater pipe line mileage than any other state, showed an increase in natural gas distribution for the ten-year period ended 1929, of over 500 per cent," says the bulletin, "the consumer increase being in about the same proportion. In 1920 natural gas distribution was 21,667,407,050 cubic feet, increasing to 103,021,902,000 in 1929. Number of consumers increased from 94,306 in 1920 to 422,014 in 1929. Average Texas price per 1000 cubic feet of natural gas was 42.3 cents."

Southwestern Gets New Contract

MALCO REFINERIES, INC., have awarded a contract to the Southwestern Engineering Corporation of Los Angeles for the erection of a modern refinery of 1,500 barrels daily capacity at Artesia, New Mexico.

The plant is similar to one recently built for Monarch Refining Company at Venice, Calif. The output of the refinery will be marketed under the trade name of Malco products and will include gasoline, gas, oil, fuel oils, kerosene and distillate.

Murray Tool and Supply Moves Headquarters

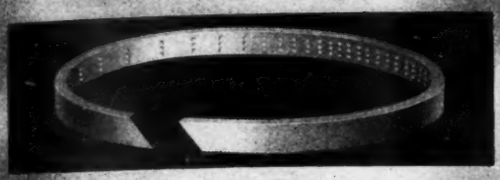
HEADQUARTERS of the Murray Tool and Supply Company have been moved from Cleveland, Oklahoma, to Tulsa with the consolidating of the two offices. Offices of the company will be maintained in the Philtower Building, Tulsa.

Correction

On page 113 of the Midyear number of The Petroleum Engineer, under the final yields of crude, the gas oil yield should read 13.7 per cent.

Refining Pennsylvania Crude Oil, by C. M. Ridgway.

American Hammered Piston Rings



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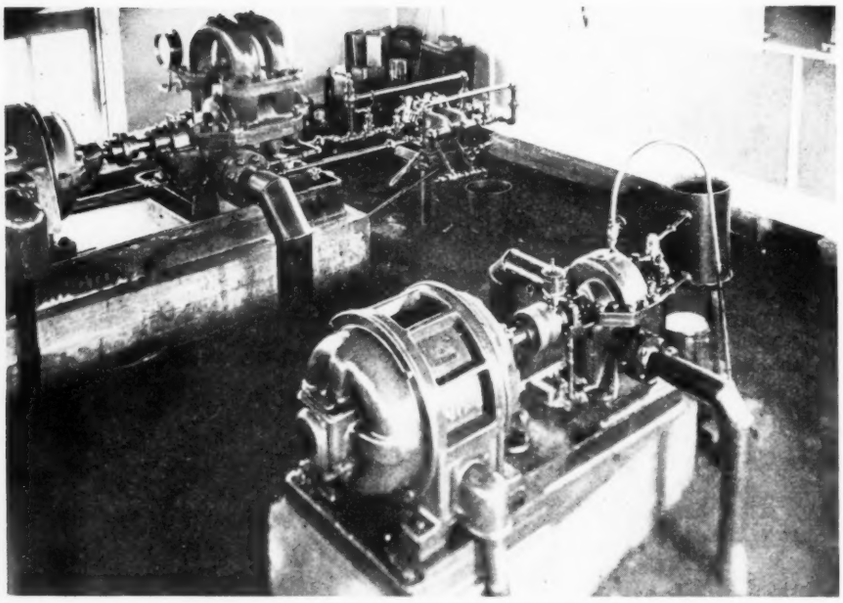


Interior of station.

...Gas Losses Reduced by Traps at El Dorado

WITH the use of a specially designed trap interconnected with vapor-tight tanks, the pipe line department of the Standard Oil Co. of Kansas has materially reduced evaporation losses at its field stations and at the same time reduced the danger of an air-gas mixture in the stations' working tanks.

One of these installations is the El Dorado (Kan.) station, adjacent to the El Dorado field. This station handles crude gathered in El Dorado and delivers it through a 6-inch line to Sallyards station, 23 miles distant. Sallyards station is located at an elevation 100 feet higher than El Dorado station.

The pumping equipment in El Dorado station is comprised of two motor-driven centrifugal pumps. The smaller of these is a single-stage pump designed to deliver 6,500 barrels daily and the larger is a multistage unit with a rated capacity of 9,000 barrels daily. They deliver direct to the suction of the centrifugal units in Sallyards station, which is on the main line to the company's refinery at Neodosha, Kan.

Gas traps hooked to tank gas lines.

With the method followed at El Dorado, two working tanks are required, along with two specially designed traps. Both tanks are vapor-tight and the piping installation is all welded in construction. Both tanks are interconnected with a gas line entering through the top of each tank, permitting the gas from one tank to flow into the other as it is emptied.

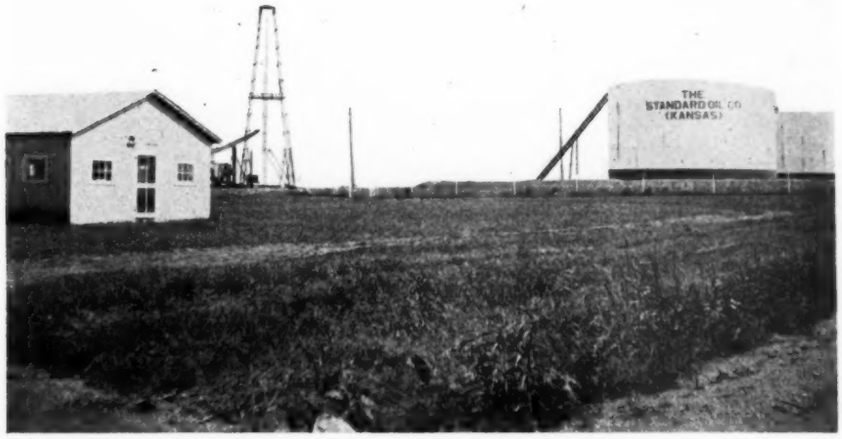
The gas traps are located outside of the fire walls and the two tanks are connected to the traps with 6-inch lines. The traps are steel shells 36 inches in diameter and 3 feet 6 inches high. A liquid seal is maintained in the bottom of shell and a baffle plate extends from the top to near the bottom. The 6-inch gas inlet pipe, connected to the line tied into the tanks, is located on the side of the shell, sealed off by the baffle plate and liquid. A hinged door is located over the atmosphere opening on the other side of the shell. The door is so designed that it cannot close entirely and thus close off the atmosphere opening.

The door is covered with a cone-shaped protector to prevent rain from getting in and changing the liquid level maintained in the tank. A sight glass level indicator is on the outside of the tank to show the station operator what level is being maintained in the shell.

Suction lines to the station's pumps are located at the bottom of the tank and as oil is being pumped from one tank the other is being filled. During this operation gas from the filling tank flows into the working tank as it is emptied. By regulating the liquid seal in the shell, which is water during the summer and oil during the winter, desired pressures may be maintained in the two tanks.

If an insufficient quantity of gas is going into the working tank a sufficient quantity of air may be drawn in through the traps to maintain the desired pressure in it. Conversely, an excess volume of gas, during expansion periods, will go through the traps to the atmosphere when

Evaporation duced With Field Station



General view of El Dorado station.

the pressure reaches a predetermined point in the working tanks.

By controlling the pressure in the two tanks the evaporation losses are reduced and the air-gas mixture is reduced to a less dangerous hazard. It has been the experience of operators in this district that when lightning struck a tank where close control of the air-gas mixture in the tank was maintained, the subsequent explosion and fire was not severe in its inception. The fires, too, were more easily extinguished and confined.

A gate valve is located on the 6-inch line connecting both tanks and between the two traps. This will permit the use of one tank while the other is undergoing repairs. The overhead lines are supported by A frames, set in the ground, and made with otherwise junk pipe. The entire installation, including the tanks, is kept neatly painted to not only add attractiveness to the station, which is located near a highway, but to deflect the rays of the sun during hot weather. The tanks are enclosed with a woven wire fence.

The station itself reflects the same care and neatness. Designed for field station work and consequently an indefinite period of operation, it does not have many of the permanent features of a main line station. The floor was made with packed chat and oiled. The station building is of frame construction with composition side wall panels, and a sheet metal exterior and roof.

One operator handles all of the station work and he lives in a cottage adjacent to the station. Communication between the station and main line is maintained by telephone.

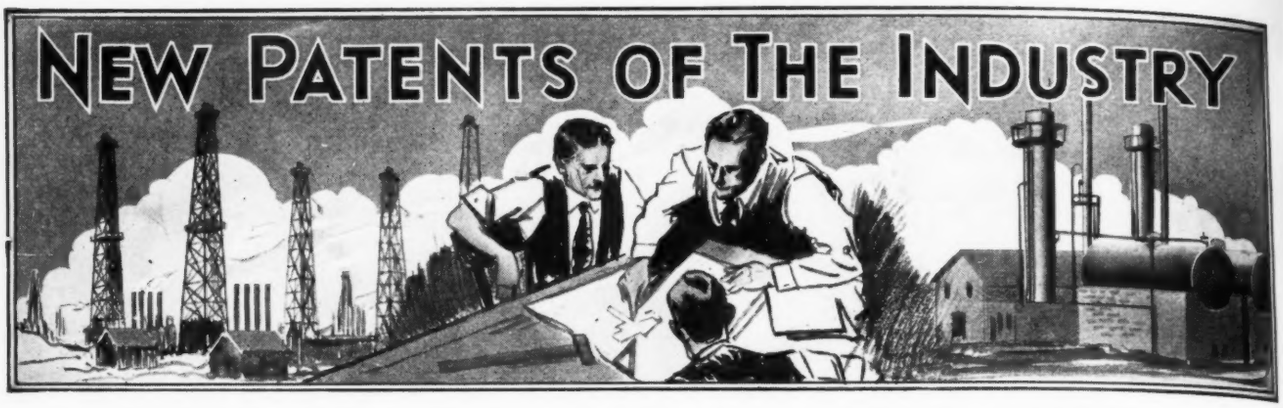
Protective measures for such as a plugged line or broken line are operated through the electric flow meter. If the pressure rises too high or drops too low the pen arm on the recorder of the flow meter causes an electrical contact to be made with an alarm bell and siren. The operator may be anywhere about the premises when the danger alarm is sounded and may quickly shut down the units and open the by-pass until the source of trouble is found and repaired.

All of the gauging is done by the station operator, who gauges the tanks with gauge lines. The flow meter is used as a check meter and to insure the station being operated at desired pressures and periods. This is indicated on the recording charts on the meter. Indicating gauges are installed on the pumps and one on the main line going to the next station.

The pumps and motors, directly connected with flexible couplings, are mounted on concrete blocks. All of the station piping is welded and the manifold and header gates are located outside of the building. The two-stage pump is lubricated with crude oil which is strained before going to the bearings.

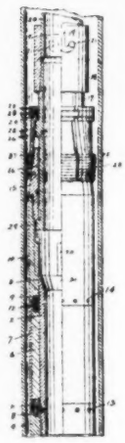
The larger pump is driven by a 440-volt, 150-horsepower, 3,540 r. p. m. motor and the smaller pump is driven by a 440-volt, 60-horsepower, 3,525 r. p. m. motor. The line is usually operated at a pressure of 310 pounds. Power is obtained from a power company's high line with a short lateral branching off to the station's transformers.

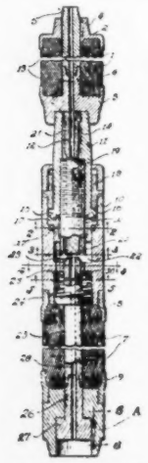
Electric flow meter.



1,804,619. PACKER. GRANVILLE A. HUMASON, Houston, Tex. Filed November 23, 1929. Serial No. 409,222. 8 Claims. (Cl. 166—12.)

8. A packer including a tubular packer support, an expansible packing element thereon, a tubular screen support below the packer support, a tubular section connected to the packer support and having a swiveling connection with the screen support and including a downwardly tapering lower expander, casing engaging means about said expander and having a releasable threaded connection with said tubular section, a yieldable seat supported on said screen support and whose upper end engages said casing engaging means, a setting nipple above said packing element and having an upwardly tapering upper expander, casing engaging means about said upper expander, means having a threaded connection with said setting nipple said last mentioned means and said last mentioned casing engaging means having means which interengage and through which the latter may be actuated by the former out of casing engaging position.

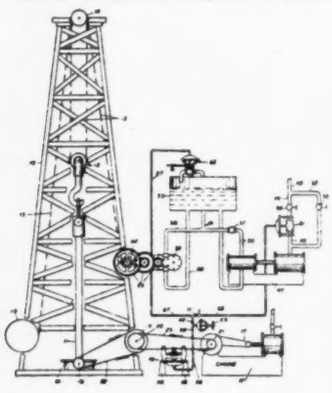




1,804,620. SAND TESTING TOOL. FRANK HUX, Bruni, Tex., assignor to Standard Drilling and Sand Testing Company, Webb County, Tex., a Corporation of Texas. Filed July 1, 1929. Serial No. 375,171. 5 Claims. (Cl. 166—1.)

1. A sand testing tool for oil wells, comprising a housing, a tubular element rotatably seated and projecting into the upper end of the housing and extending thereabove; a tubular element seated and projecting into the lower end of the housing and depending therebelow; a valve threadly-engaged with said upper tubular element, said valve channeled from end to end and adapted to provide open communication with and between said upper and lower tubular members when a test of the well is being had; the valve being lowered to open and closed positions before and after the test is secured by a right-hand rotation of said upper projecting element; in combination with packers above and below said housing.

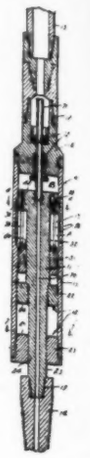
1,804,779. MECHANICAL ROTARY DRILLING CONTROL. PHILIP JONES and PAUL W. PRUTZMAN, Los Angeles, Calif. Filed June 24, 1929. Serial No. 373,369. 8 Claims. (Cl. 255—19.)

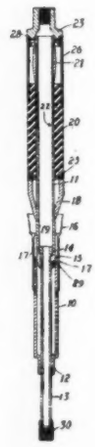


1. In an apparatus for rotary well drilling including a drill string, a rotary table for revolving said string, a drilling line for partially supporting the weight of said drill string, a secondary feeding means associated with said drilling line and operated by fluid pressure for raising and lowering said drill string, and a prime mover adapted to drive said rotary table through the medium of a flexible band of which one side is in tension; a device for controlling said secondary feeding means comprising: means for deflecting the tension side of said band from a straight line; means for transmitting the thrust of said deflecting means to a fixed collapsible reservoir containing liquid, thereby displacing a portion of said liquid; and means for transmitting said displaced liquid to a pressure-responsive means adapted to regulate the pressure of liquid in said secondary feeding means.

1,804,700. JARRING TOOL. WILLIAM H. MAXWELL, Los Angeles, Calif. Filed April 5, 1927. Serial No. 181,060. 3 Claims. (Cl. 255—27.)

1. A well tool of the character described including two sections having co-operating parts forming a closed compression chamber and a closed receiving chamber, means for admitting fluid freely from the receiving chamber to the compression chamber, and means for freely passing fluid from the compression chamber after the fluid in the compression chamber has operated to retard movement between the sections, there being a fluid circulation opening through the tool.



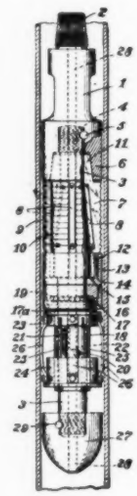


1,804,818. WELL PACKER. GEORGE A. SPANG, Butler, Pa., assignor to Spang and Company, Butler, Pa., a Corporation of Pennsylvania. Filed March 11, 1929. Serial No. 345,933. 7 Claims. (Cl. 166—12.)

1. A well packer having in combination a tube, a sleeve of resilient well packing material thereon, means on said tube for expanding said sleeve into sealing engagement with the wall of the well hole, packer supporting slips adapted to engage said wall for supporting said packer in position and an actuator slidable within said tube, adapted to be operated by engagement with the bottom of the well hole for simultaneously operating said expanding means and said slips.

1,804,819. SIDEWALL DRILLING ORGANIZATION. EDWARD A. SPENCER, JR., Los Angeles, and FAY OLIVER, Whittier, Calif. Filed May 2, 1928. Serial No. 274,406. 15 Claims. (Cl. 255—61.)

1. A sidewall channeling organization, for use in underground bore holes, comprising: a main body member; means for suspending said body member from a drill string; a drill member adapted to be projected laterally from said body member; and means rotatable relative to said body member for imparting rotation to said drill member from said drill string.



1,794,864. ROTARY TRIP SPEAR. ORDA D. NUTTER, Parkersburg, W. Va., assignor to Acme Fishing Tool Co., Parkersburg, W. Va., a Corporation of West Virginia. Filed June 6, 1928, Serial No. 283,358. Renewed Aug. 2, 1930. 7 Claims. (Cl. 294—96.)

1. A trip spear comprising a head and a body, a series of slips engageable with the body, a slip retainer carried by a trip sleeve, and a friction spring for carrying the weight of the spear in a casing, the retainer being freely rotatable relative to the slips.